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EXPLORING THE PERSISTENCE OF FEMALE GENITAL CUTTING AND INTIMATE PARTNER VIOLENCE IN SUB-SAHARAN AFRICA

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ABSTRACT

Female genital cutting (FGC) and intimate partner violence (IPV) both involve individuals causing harm to a close family member. Their global impact on health and well-being is considerable; 3 million girls are at risk of FGC every year and 30% of women experience IPV in their lifetime. The persistence of these paradoxical behaviours is of interest to both evolutionary scientists and policy makers. Despite intense research and programme activity, the motivations for both behaviours remain elusive, and implementing behavioural change has proved challenging.

In this thesis I explore the persistence of FGC and IPV with three main objectives; 1) to gain further understanding of risk factors, 2) to test whether evolutionary theory can explain perpetrator motives, and 3) to draw out implications relevant to policy work. Throughout, I test commonly held assumptions concerning these behaviours. These objectives are investigated in four research chapters (two published and two written for submission) using secondary datasets from countries in sub-Saharan Africa.

The results show that women who conform to the FGC norm within their community have higher evolutionary fitness, and that paternity concern may also influence FGC behaviour via marriage preferences. The policy implications include targeting communities in which FGC is the majority behaviour. IPV types are found to be associated with different perpetrator motives, and diverging evolutionary interests between husbands and wives (sexual conflict) increases the risk of men perpetrating physical but not sexual IPV. This suggests that IPV programmes should address IPV sub-types separately. Finally, I find no association between FGC status and IPV experience. This indicates that eradication programmes tailored to the specific risk factors involved in either IPV or FGC will be more effective. The results demonstrate some novel risk factors relating to FGC and IPV, and reveal how evolutionary and cultural forces may contribute towards their persistence.

DEDICATION AND ACKNOWLEDGEMENTS

This thesis is dedicated to my children, Holly, Max and Gemma who have been my biggest cheerleaders during my research. Their belief in me and their sweet words of encouragement have spurred me on. Their birth also set me on the path to this research, albeit on a slightly circuitous route, as my wonderings as a new mother about how infant care was approached around the world returned me to my anthropological roots.

Huge thanks go to my supervisor, Mhairi Gibson. I am extremely grateful for her time, encouragement and support over these past few years. Her knowledge and passion for the subject has been inspiring, and it has been a privilege to learn from her. I have enjoyed our discussions, and appreciate her encouragement to present and publish my research. Her insightful comments and guidance have been invaluable in honing my skills as an evolutionary anthropologist.

I'd also like to thank the tower room gang, particularly Alarna Samarasinghe, Sam Passmore and Caitlin Greenwood for their companionship on this PhD journey.

Many friends and family have given me support along the way. In particular I would like to thank my brother Martin for his inspiration, and my parents for always being there for me. A special mention goes to my dear friend Kirsten Knull for her enthusiasm for my research, and the biggest thank you is to my husband Gavin, for his unfailing support and encouragement.

AUTHOR'S DECLARATION

I declare that the work in this dissertation was carried out in accordance with the requirements of the University's Regulations and Code of Practice for Research Degree Programmes and that it has not been submitted for any other academic award. Except where indicated by specific reference in the text, the work is the candidate's own work. Work done in collaboration with, or with the assistance of, others, is indicated as such. Any views expressed in the dissertation are those of the author.

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

DFID	Department for International Development (UK)
DHS	Demographic health surveys
FGC	Female genital cutting
FGM	Female genital mutilation
HIC	High income countries
IPPV	Intimate partner physical violence
IPSV	Intimate partner sexual violence
IPV	Intimate partner violence
LMIC	Low- and middle-income countries
VAWG	Violence against women and girls
WHO	World Health Organisation

CHAPTER 1 INTRODUCTORY CHAPTER

1.1 INTRODUCTION

This thesis examines two harmful practices; female genital cutting (FGC) which is defined as 'all procedures involving partial or total removal of the external female genitalia or other injury to the female genital organs for non-medical reasons' (WHO et al., 1997); and intimate partner violence (IPV) which is defined as 'any behaviour within an intimate relationship that causes physical, psychological or sexual harm' (WHO, 2012a). IPV can be perpetrated by either sex, however in this thesis, study is restricted to male-to-female IPV. Overviews of FGC and IPV are described in Sections 1.3 and 1.4.

FGC and IPV have been studied by many disciplines since the prevalence and public health impact of both behaviours became apparent in the 1990s (Wade, 2012). Anthropologists have made important contributions to this body of work. Anthropology is founded on the principles of impartial observation and seeking to understand behaviours in their local context, and also has a history of tackling sensitive subjects (McClusky, 2001). Anthropologists have documented FGC from the perspective of practising communities and offered alternative explanations for FGC to those given by feminist and human rights activists, described in Section 3.1 (Shell-Duncan and Hernlund, 2000;Gruenbaum, 2001b;Sarkis, 2004). Anthropologists have also provided a cross-cultural perspective on IPV perpetration and have been involved in developing culturally sensitive interventions, described in Section 3.1.2 (Levinson, 1989;Counts et al., 1992;Klevens et al., 2007).

More recently evolutionary anthropologists have also started to address harmful practices, demonstrating that an evolutionary anthropological approach can reveal previously unrecognised motivations for human behaviour, reviewed in Section 2.5 (Nettle, 2010;Nettle et al., 2013;Gibson and Lawson, 2015). Evolutionary models, as described in Section 2.4, uniquely predict that behaviours that are detrimental to health and well-being may be maintained in a population provided they lead to higher evolutionary fitness (Hill, 1993). FGC and IPV are both associated with negative health consequences which could reduce the evolutionary fitness of those involved, yet both behaviours are widespread in many populations (Ellsberg et al., 2008;Berg and Underland, 2013). An evolutionary anthropological approach may reveal further motivations for FGC and IPV perpetration.

Many other disciplines have also addressed the question of why FGC persists, and why men perpetrate IPV. These include human rights and feminist activists (Hosken, 1979;Dobash and Dobash, 1979;Thomas and Beasely, 1993;Heise, 1996;Wade, 2012) demographers and policy makers (Garcia-Moreno et al., 2006;Ellsberg et al., 2008;Yoder and Wang, 2013;UNICEF, 2013), economists (Chesnokova and Vaithianathan, 2010;Duvvury et al., 2013), lawyers and criminologists (Thomas and Beasely, 1993;Tobin,

2009), social scientists (Gelles and Straus, 1979;Gelles, 2007;Hamberger and Larsen, 2015), and psychologists (Bell and Naugle, 2008;Finkel et al., 2009;Buss and Duntley, 2011;Mulongo et al., 2014). Contributions from these disciplines relevant to the research objectives of this thesis are discussed in Chapter 2 (FGC) and Chapter 3 (IPV).

In this introductory chapter the justifications for studying FGC and IPV are explained. An overview of the pertinent facts relating to IPV and FGC is given, describing prevalence, geographical distribution and variance in practice. This is followed by an outline of the thesis objectives and a description of the thesis structure.

1.2 WHY FOCUS ON FGC AND IPV?

My research interests are to explore whether a cross-cultural evolutionary approach can help to understand the prevalence of harmful practices. There are several compelling reasons why FGC and IPV in particular were chosen as subjects for study.

Firstly, FGC and IPV are international development agenda priorities (UN, 2016). The negative effects on women and girl's health and well-being resulting from IPV and FGC, as well as their widespread impact, has prompted international action (Toubia, 1995;Ellsberg et al., 2008;UNAIDS et al., 2008;WHO/LSHTM, 2010;Berg and Underland, 2013). The goal of eradicating both behaviours is recognised in several international instruments, including the Convention on the Elimination of All Forms of Discrimination against Women (UN General Assembly, 1979), the Convention on the Rights of the Child (UN General Assembly, 1989) and the Declaration on the Elimination of Violence against Women (UN General Assembly, 1993). Additionally, the United Nation's Sustainable Development Goals (SDGs) adopted by all United Nation member states in 2015, includes a goal relating to gender equality, with specific targets aimed at IPV and FGC (UN, 2016). Target 5.2 is to eliminate all forms of violence against women and girls, monitored by progress indicators which include the proportion of women aged 15-49 years subjected to IPV. Target 5.3 is to eliminate all harmful practices 'such as child, early and forced marriage and female genital mutilation' monitored by progress indicators which include the proportion of girls and women aged 15-49 years who have undergone FGC (UN, 2016).

Secondly, FGC and IPV are both widely prevalent behaviours, unlike some other harmful practices which may be refined to a small number of ethnic groups (Watts and Zimmerman, 2002;Johnston and Riordan, 2005;LaTosky, 2015). The prevalence of IPV and FGC allows their persistence to be explored in a range of contexts. Further, the priority given to FGC and IPV by the international community means that relevant data has been collected by organisations such as the Demographic Health Surveys (DHS) to monitor progress against development targets (described in Section 1.6). These publicly available datasets are a rich resource with which to address my research questions.

Thirdly, FGC and IPV both merit individual study, and additionally the frequent grouping of these two behaviours suggests that a benefit can be gained from their joint study (UN Women, 2017a). FGC and IPV are at the intersection of two types of behaviour; violence against women and girls (VAWG) and harmful cultural practices. It is frequently claimed that FGC and IPV share the same root causes, relating to a patriarchal structure of society and gender inequality (UN General Assembly, 1993;UN, 1995).

VAWG is defined as 'any act of gender-based violence that results in, or is likely to result in, physical, sexual or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life' (UN General Assembly, 1993). There is no standardised definition of harmful cultural practices, but they are typically considered to be culturally acquired and culturally condoned behaviours which cause immediate or long-term negative health consequences, and often, although not exclusively, are imposed on individuals by their relatives (UN, 1995). Examples include female infanticide, early marriage, early pregnancy, dowry practices, widow inheritance, scarification and other forms of traditional surgery (UN, 1995). Harmful cultural practices are also normally understood to be practices found in low- and middle-income countries (LMIC) that are gender-based and discriminatory towards women and girls (Winter et al., 2002;Longman and Bradley, 2015b). Other forms of VAWG and harmful cultural practices have been found to be associated, but the association between FGC and IPV is unclear from the existing literature (Refaat et al., 2001;Salihu et al., 2012;Peltzer and Pengpid, 2014;Hayes and van Baak, 2017;Ramage, 2018). This is addressed further in Chapter 8.

Finally, few studies have applied an evolutionary anthropological approach to either FGC or IPV perpetration to date or tested whether evolutionary drivers might be contributing to their persistence. The existing evolutionary anthropology literature relating to FGC is discussed further in Section 3.2.4 and relating to IPV in Section 4.2.8. These research gaps presented an opportunity to explore FGC and IPV behaviour with a new perspective and make an original contribution to the literature.

1.3 OVERVIEW OF FEMALE GENITAL CUTTING

1.3.1 Terminology used to describe FGC

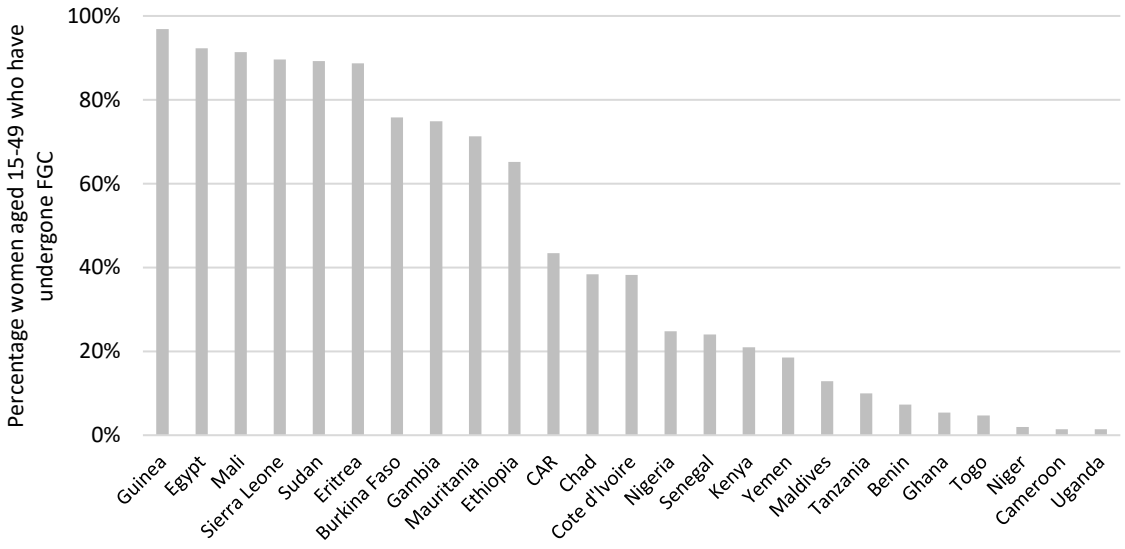
Throughout this thesis the term FGC is used, even when referring to literature in which alternative terms were used. Studies in the early 20th century tended to refer to the specific FGC forms such as excision or infibulation (described in Section 1.3.3), or used terms such as 'genital surgeries', 'operations based on customs' or more commonly 'female circumcision' (Worsley, 1938;Mustafa, 1966;Verzin, 1975;UN, 1995). In the 1970s feminist activists campaigning against the practice introduced the term female genital mutilation (FGM) as it was felt that 'female circumcision' implied an equivalency with male circumcision which ignored the seriousness of the health consequences experienced by women

(Hayes, 1975;Hosken, 1979). FGM was subsequently adopted by international agencies in the 1990s, such as the Inter-African Committee, the World Health Organisation (WHO), and the United Nations (UN). However, FGM is also contentious and has been objected to by women from practising communities who consider this terminology to be offensive and insensitive, and who did not identify with being mutilated (Antonazzo, 2003;Khaja et al., 2009). Subsequently the more neutral term FGC has been used. FGM and FGM/C are both still commonly used, however the choice of term is still considered politically loaded (Wade, 2012).

1.3.2 Geographical distribution and prevalence of FGC

FGC is predominantly practised in 29 countries, primarily in sub-Saharan Africa, as well as Indonesia, Yemen and Iraq (UNICEF, 2016). The prevalence of FGC varies substantially within these 29 countries, from 1% in Cameroon and Uganda, to 97% in Guinea, as illustrated in Figure 1.1. It is estimated that globally between 200-300 million women have undergone some form of FGC and that a further 3 million girls aged 0-14 years are at risk of being cut every year (Yoder et al., 2013;UNICEF, 2016). FGC is also practised in diaspora communities throughout the world (WHO, 2012b).

Figure 1.1 FGC prevalence for women aged 15-49 years in African countries surveyed by the DHS



Source: Measure DHS statcompiler, using most recent survey data for each country

FGC prevalence is monitored through women's self-report gathered from national demographic surveys, as physical examination is infeasible to use on a large scale (Gibson et al., 2018). Studies which have compared physical examination to self-report suggest that self-report is often, although not always, accurate e.g. (Okonofua et al., 2002;Elmusharaf et al., 2006;Bjälkander et al., 2013). This is discussed further in Section 9.6.2.

1.3.3 Variation in FGC practice

FGC refers to a range of procedures which vary by severity of cutting, the age at which cutting is performed, who performs the procedure, the degree of ceremony involved, and the local beliefs which sustain the practice. Ethnic group is the primary determinant of these variations, and whether a woman has undergone FGC, as well as the specific FGC form, can be an important marker of ethnic identity (Abusharaf, 2001;Gruenbaum, 2005;Pemunta, 2012;Yoder and Wang, 2013;Kaplan et al., 2013b;Ross et al., 2016).

The WHO classifies FGC into four types by cutting severity (WHO, 2014). Type 1, or clitoridectomy, describes the partial or total removal of the clitoris. Type 2, or excision, describes the partial or total removal of the clitoris and labia. Type 3, or infibulation, describes the narrowing of the vaginal opening through creating a seal, usually formed by cutting the labia and stitching together, with or without removal of the clitoris. Type 4 includes procedures which don't fall within these categories including 'nicking', scraping, cauterising or elongating the genitals (WHO, 2014). Alternatively the DHS, which is used in this thesis, uses descriptive terms rather than the WHO classification and asks respondents whether any flesh was removed from the genital area, whether the genital area was just nicked without removing any flesh and whether the genital area was sewn (Yoder et al., 2004). Globally it is estimated that of women who have undergone FGC, around 10% are infibulated, 10% are nicked with no flesh removed, and 80% undergo clitoridectomy or excision, although these proportions vary by country (UNICEF, 2013).

The age at which FGC is performed ranges from infancy to marriage, and occasionally later. Although there are norms by ethnic group, there is also variation within each group (Yoder et al., 2004). In many West African ethnic groups it is common for girls to undergo FGC in infancy or before the age of 5 years. However, in some ethnic groups in Liberia and Sierra Leone FGC takes place in adolescence as part of girls' initiation into women's societies (Ahmadu, 2000;Dellenborg, 2004;Bjälkander et al., 2012). In some East African countries (e.g. Kenya, Central African Republic, Somalia) the procedure also may be an element of a puberty rite or coming-of-age ceremony (Dorkenoo, 1994;Yoder and Wang, 2013). Elsewhere, as in Ethiopia, women undergo FGC just prior to marriage (Gibson et al., 2018). It has been observed that the age at FGC is lowering in many countries and the ceremonial or symbolic elements are becoming less common. This is understood to be a reaction to eradication programmes, as cutting at a younger age is harder to detect (Hernlund, 2000;Pemunta, 2012;Yoder and Wang, 2013;Camilotti, 2016).

Mothers are described as the primary decision-makers for FGC, who also make the practical arrangements for the procedure (Caldwell et al., 2000;Shell-Duncan et al., 2000b;Gruenbaum,

2001b;Kaplan et al., 2013a). However, husbands and other family members, particularly older female relatives, may be involved in the decision, via tacit disapproval or approval or by putting pressure on the mother (Shell-Duncan et al., 2000;Yount, 2002;Shell-Duncan and Herniund, 2006;Bjälkander et al., 2012). This is discussed in Section 9.6.3. Most commonly the procedure is performed by a traditional practitioner (80% of cases according to a recent estimate (Yoder and Khan, 2008)) who is paid in some form for their services. The procedure is usually performed with a razor blade or small knife without anaesthetic. In some cases, the procedure may be performed communally among peer groups of girls, or more commonly it takes place in the home (Nour, 2008;Yoder and Wang, 2013;Shell-Duncan et al., 2018). In countries where a 'harm reduction' rather than eradication approach has been taken, the procedure is increasingly being performed by medical personnel in contravention of international protocol. Data from the most recent DHS surveys show that in Egypt, Sudan and Kenya, 20-30% of FGC procedures were medicalised (UNICEF, 2013;Yoder and Wang, 2013).

The beliefs and meaning ascribed by practising communities to FGC are varied and overlapping (Adongo et al., 1998;Shell-Duncan and Hernlund, 2004). Survey data, supported by ethnographic accounts, suggests that the reasons most commonly reported are social acceptance and following tradition (Yoder et al., 2004;UNICEF, 2013). More specific local beliefs are wide-ranging although there are some common themes which include; preserving premarital virginity or FGC being a prerequisite for marriage (Oyefara, 2014;Shell-Duncan et al., 2018;Sabahelzain et al., 2019), raising a girl properly and preparing her for adulthood (Mackie and LeJeune, 2009;Abathun et al., 2016), beliefs regarding body cleanliness, femininity and beauty (El-Tom, 1998;Oyefara, 2014), avoiding social stigma associated with not having undergone FGC (Hernlund, 2000;Boyden et al., 2012;Pankhurst, 2014), embedded within coming-of-age rituals (Ahmadu, 2000;Dellenborg, 2004;Bjälkander et al., 2012), or to enhance a husband's sexual pleasure (Berggren et al., 2006). The belief that FGC is proscribed by religion, specifically Islam, is also common although this varies by context (Almroth et al., 2001a;Sabahelzain et al., 2019). The roots of FGC are known to predate Islam and religious doctrine does not explain the origin of FGC (Yount, 2004). FGC is practised by several Christian and Catholic ethnic groups in Africa (Mackie and LeJeune, 2009;Hayford and Trinitapoli, 2011). Local interpretations of religious scripture may be more important than religious affiliation (Yount, 2004;Hayford and Trinitapoli, 2011). Theoretical interpretations of FGC motivations are discussed in Section 3.2.

1.3.4 Health consequences associated with FGC

The health consequences resulting from FGC recognised by the WHO include; short-term complications immediately following the procedure such as haemorrhaging or infection; long-term complications such as chronic pain, infections, infertility, increased risk of sexually transmitted infections and urinary

problems; obstetric complications; and psychological trauma (UNAIDS et al., 2008;WHO, 2014). Infibulation is associated with the most severe health consequences (Yoder and Wang, 2013).

Establishing the health consequences resulting from FGC with any certainty is challenging, and this has been a source of controversy for anti-FGC campaigners (discussed in Section 3.1.1). The available evidence is scarce, and studies are often based on hospital admissions which are not representative samples (Obermeyer, 2005). The immediate consequences of FGC are particularly difficult to determine unless they result in hospital admission (Obermeyer, 2005). Variation in FGC practice also prohibits drawing any general conclusions regarding health consequences as the girls' age, the severity of cutting, and the hygiene conditions all affect the medical outcome (Obermeyer, 1999).

One of the first systematic reviews examining the health consequences of FGC found no evidence of FGC related mortality and concluded that severe consequences were relatively infrequent (Obermeyer, 1999). This study challenged the view that FGC was inevitably detrimental to health, to the concern of anti-FGC campaigners (Mackie, 2003). Although many studies and systematic reviews have been conducted since, the results are mixed. Some cross-country meta-analytic studies have confirmed negative health consequences, particularly in relation to obstetric complications, and found that greater severity of cutting was associated with higher risks (Banks et al., 2006;UNAIDS et al., 2008;Adam et al., 2010;Berg and Underland, 2013). However, other studies have found limited evidence of general health impairments, long-term consequences or obstetric complications (Morison et al., 2001;Obermeyer, 2005;Wagner, 2015).

Other negative impacts on well-being resulting from FGC, such as pain and trauma, are less easily captured in quantitative studies. These aspects have been documented in personal accounts, qualitative studies or by ethnographers, however the extent of these effects are unknown (El Dareer, 1982;Ahmadu, 2000;Dellenborg, 2004;Prazak, 2016). Studies which have examined the psychological consequences resulting from FGC suggest that the psychological impact of undergoing FGC is affected by the girl's understanding of what was going to take place, and the circumstances of the cutting (Mulongo et al., 2014;Smith and Stein, 2017). The consequences for women's sexual health and sexual pleasure have also been studied, but the results are also mixed (Obermeyer, 2005a;Berg and Denison, 2012a;Anis et al., 2012;Nyairo, 2013). This is discussed further in Chapter 5.

1.3.5 Male circumcision

Male circumcision prevalence is close to 100% in many countries where FGC is practised, and FGC and male circumcision may be viewed equivalently by practising communities (Kennedy, 1970;Morris et al., 2016). Male circumcision is also prevalent in many countries where FGC is not practised, for example the USA (71.2% prevalence) or the UK (20.7% prevalence) (Morris et al., 2016). Like FGC, health

complications arising from male circumcision have been documented, and like FGC, more extreme forms are also practised, although they are uncommon (Wilson, 2008). However, the WHO has deemed that the low risk of complications resulting from male circumcision, when performed by well-trained providers in hygienic settings, is outweighed by the potential health benefits, in particular reducing the risk of HIV acquisition by 60% (UNAIDS et al., 2008). The inconsistency of condemning the mildest forms of FGC while condoning male circumcision has been commented on by anthropologists (Shell-Duncan et al., 2000;Johnsdotter, 2018).

1.4 OVERVIEW OF INTIMATE PARTNER VIOLENCE

1.4.1 Terminology used to describe IPV

Various terms have been used to describe intimate partner violence (IPV), and their use often reflected a theoretical divide between researchers. Feminist scholars, who identify IPV as a gendered activity perpetrated by men against women, have used terms such as wife abuse, wife beating, wife battering, and violence against women (Dobash and Dobash, 1979;Kurz, 1989). Researchers who predict sex-symmetry in IPV perpetration have been more likely to use terms such as spouse abuse, marital violence, and domestic violence (Gelles and Straus, 1979). These theoretical stances are discussed further in Section 4.2.4 (Feminist Theory) and Section 4.2.5 (Family violence Theory).

Since 2002 the WHO has defined IPV as 'any behaviour within an intimate relationship that causes physical, psychological or sexual harm to those in the relationship, including acts of physical aggression, sexual coercion, psychological abuse and controlling behaviours' (WHO, 2012c). This makes it clear that IPV can be perpetrated by women and men, and can occur within same-sex or heterosexual partnerships.

Throughout this thesis the term IPV is used even when referring to literature in which alternative terms were used. IPV perpetrated by men towards their female intimate partners is the specific focus of this study, and throughout this thesis IPV refers to this specific form of IPV unless otherwise specified.

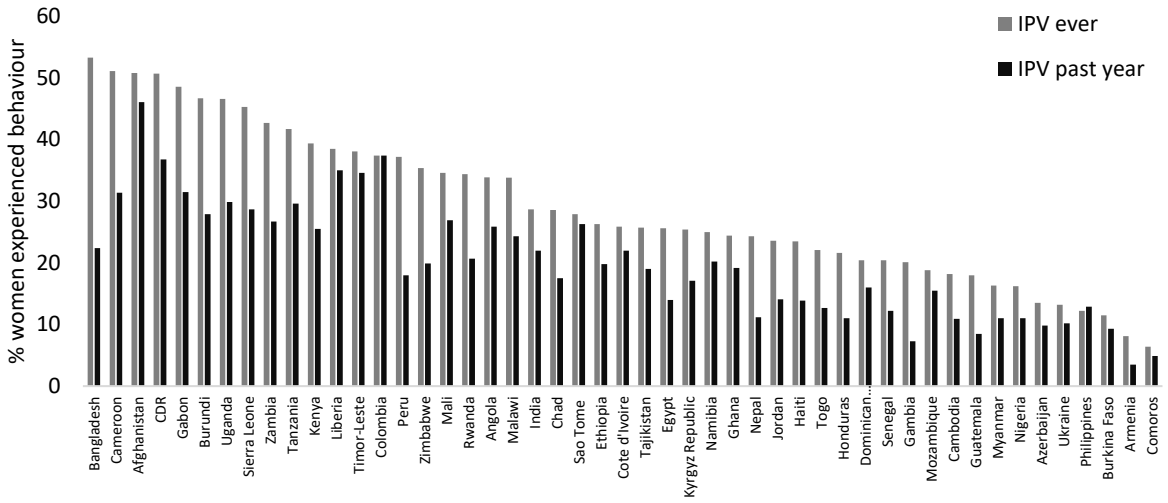
1.4.2 Geographical distribution and prevalence of IPV

IPV is a global phenomenon found in all countries and all socioeconomic settings (WHO, 2012c). Ethnographic studies have documented a small number of societies in which IPV is virtually absent, which is used to suggest that IPV is not an inevitable element of human culture (Levinson, 1989). However, it is unclear how representative these observations are of general behaviour among these small societies.

The most recent WHO report estimates that globally 30% of women in a relationship have experienced IPV (WHO et al., 2013). The average IPV prevalence in high income countries (HIC) is 23% (North

America, Western Europe, Australia and New Zealand (WHO et al., 2013). IPV rates in LMIC vary widely from 53% of women in Bangladesh who have ever experienced IPV to 5% in Comoros (illustrated in Figure 1.2). This range in country prevalence highlights the importance of context in determining IPV occurrence (García-Moreno et al., 2005;WHO et al., 2013;Kimuna et al., 2018).

Figure 1.2 Percentage women in LMIC who have experienced IPV ever and in the past year



Source: Adapted from data compiled by the World Health Organisation (WHO et al., 2013)

IPV prevalence has commonly been measured using women's self-reported IPV experience, rather than men's self-reported IPV perpetration, although this has started to change in the last decade (Abramsky et al., 2011;Fleming et al., 2015). The DHS and other surveys typically ask female respondents about a list of specific IPV acts experienced during the past year or during their lifetime, which range in severity from being pushed to forced intercourse. The frequency of each type of violence is not usually captured in surveys, and the resulting measurement is binary (did/did not experience IPV) rather than quantitative (WHO/LSHTM, 2010). As with all self-reported experiences, there is a risk of reporting bias. Studies indicate that underreporting is more prevalent than overreporting, however this is difficult to verify e.g. (Ellsberg et al., 2001).

The range and severity of women's IPV experiences is not easily captured in IPV survey measurements, and there are differences in opinion, for example, whether a single instance of violence constitutes IPV (Heise, 2012). Attempts have been made to distinguish different IPV experiences although this has not become mainstream. For example, an influential sociologist identified four different patterns of violence which apply to both male and female IPV perpetration; 'common couple violence' (where frustration and anger occasionally turn physical); violent resistance (i.e. self-defence); 'intimate terrorism' (characterised by multiple forms of abuse of escalating severity); and 'mutual violent control' (Johnson, 1995;Johnson and Ferraro, 2000). More recently latent class analysis has been used to identify the types

of IPV that tend to co-occur which has shown different grouping of IPV forms by context (Heise, 2012;Roberts et al., 2018;Gupta et al., 2018).

1.4.3 Variation in IPV behaviour

The WHO definition of IPV includes any act of physical, sexual and psychological violence, however there is no standard list of behaviours for these IPV types (WHO, 2012c). Physical IPV is understood to include a wide range of violent acts, and the DHS for example asks about pushing, shaking, slapping, hitting, choking, punching, burning, kicking, threatening or using a weapon. Sexual IPV collected in surveys is often less comprehensive, and although the understanding of sexual IPV is continually being revised to incorporate a greater range of unwanted sexual activities, most surveys only collect data on forced sexual acts or forced intercourse (Basile et al., 2014;Logan et al., 2015). Psychological forms of IPV, sometimes referred to as emotional violence, controlling behaviours or coercion, can take many forms. Meaningful indicators for use in surveys have been difficult to standardise due to the difficulty of capturing nuances of behaviour, for example agreeing when an argument becomes controlling. (Heise, 2012). The interaction between the different types of IPV behaviours is not well understood (Abrahams et al., 2004;García-Moreno et al., 2005). This is discussed further in Chapter 7.

1.4.4 Health consequences resulting from IPV experience

The health consequences resulting from IPV depend on the severity and duration of IPV experience. The consequences can be extreme, and globally it is estimated that 38% of female homicides are perpetrated by an intimate partner (compared to 4% of male homicides), often after a long history of abuse (Stoeckl et al., 2013;WHO et al., 2013). In addition to physical injury which is estimated to be experienced by 42% of IPV victims, research shows that IPV can result in a wide range of other health problems (Heise and Garcia-Moreno, 2002;Jewkes, 2002;WHO et al., 2013).

IPV is associated with a greater incidence of mental health problems including anxiety, PTSD, depression and suicide attempts (Pico-Alfonso et al., 2006;Devries et al., 2013a). Women who experience IPV have been demonstrated to be more likely to acquire HIV and other sexually transmitted infections (Coker, 2007;Jewkes et al., 2010;Kouyoumdjian et al., 2013). Studies have also demonstrated a detrimental impact on maternal health leading to pregnancy loss, prematurity and infants of low birth weight (Valladares et al., 2002;Coker, 2007;Hill et al., 2016). IPV also is associated with adverse impacts on the health and well-being of children living in households in which mothers experience IPV, for example a higher risk of under 5 mortality, lower rates of immunisation, higher rates of diarrhoeal disease and general maltreatment (Dube et al., 2002;Campbell, 2002;Holt et al., 2008). However, many studies examining the health effects of IPV suffer from a difficulty with demonstrating causation rather than

correlation, and longitudinal data is required to confirm these findings whereby exposure to violence and health outcomes are measured multiple times.

1.4.5 IPV risk factors and perpetrator motives

Understanding why men perpetrate IPV is approached in two primary ways; either risk factors are identified through statistical analysis of population-based studies, or less commonly, men are asked directly about their behaviour in smaller surveys or qualitative studies (Heise, 1998). Ethnographic studies also contribute to understanding perpetrator motives (Friederic, 2011). There is increasing consensus on the most common risk factors that contribute to the likelihood of IPV occurring, identified through systematic reviews (WHO/LSHTM, 2010). Risk factors are often identified at different levels, for example factors associated with the perpetrator, the intimate relationship, the community and the wider national environment.

Risk factors identified at the individual level include experiencing sexual abuse as a child, harmful use of alcohol and drugs, poor mental health, opinions concerning the acceptability of IPV, a past history of being abusive, as well as socioeconomic factors such as low education, unemployment and poverty (Sambisa et al., 2010;Fleming et al., 2015;Machisa et al., 2016;Yount et al., 2016;Wirtz et al., 2018). Relationship factors which increase the risk of IPV include conflict and relationship dissatisfaction, men having multiple partners, educational disparity, male dominance in the family, as well as marital duration and number of children (Silverman et al., 2007;Jewkes et al., 2010;Rahman et al., 2013;Mandal and Hindin, 2013). The importance of wider societal influences on individual IPV perpetration has also been demonstrated in numerous studies, including the prevalence of gender inequitable norms, social acceptance of violence, weak community sanctions against IPV, restrictive divorce and marriage laws, and low socio-economic status (Gage, 2005;Koenig et al., 2006;Boyle et al., 2009;Ackerson and Subramanian, 2016;Yount et al., 2018;Clark et al., 2018). National factors include socio-economic development and legal frameworks (Kovacs, 2017). Theoretical frameworks which have been put forward to explain why these factors influence IPV perpetration are discussed in Section 4.2.

Men's responses to structured questionnaires on why they perpetrated IPV will reflect the research agenda of those framing the questions, meaning important factors may not be recognised (Flynn and Graham, 2010). Surveys interviewing male perpetrators have more commonly been conducted in high income country settings, and a systematic review of 50 such studies (many of which were comparing male and female motivations for IPV) found that the survey responses most commonly agreed with included control, anger, retaliation, self-defence, to get attention, and an inability to express oneself verbally (Neal and Edwards, 2017). A similar study in LMIC found that frequent conflict, male infidelity and men's attitude to IPV were important factors e.g. (Abrahams et al., 2004). The use of structured

questionnaires to elicit understanding if IPV motivation is challenging due to the sensitivity and illegality of the topic. It is also uncertain whether perpetrators are able to articulate their motives (for example in one study 30% respondents said they didn't know why they perpetrated IPV (Whitaker, 2014)). Qualitative studies, for example interviews with men incarcerated for IPV, have revealed complex relationships between adverse childhood experiences and neglect, and ideas about masculinity (Mathews et al., 2011;Mathews et al., 2015).

It is likely that perpetrator motivations will overlap and vary depending on men's personal experiences and their context. Some theorists have suggested that it is useful to distinguish immediate triggers for violence (arguments, alcohol use, provocation by partner, 'hot button' issues); triggers relating to current life circumstances (economic status, mental and physical health, relationship happiness, stress) and more latent background factors (childhood experiences, attitudes, beliefs) (Flynn and Graham, 2010), however as yet this is not common practice.

IPV has been studied most extensively in HIC populations (Hughes et al., 2014). Some experts question whether perpetrator profile, motivations and risk factors identified in HIC will apply to LMIC due to differences in economies, history, politics and culture (Abramsky et al., 2011). Although the reasons are unclear, the acceptability of IPV does seem to differ between LMIC and HIC. Data from a mixed gender world values survey shows that acceptability of IPV in HIC averages around 13% e.g. USA 15.4%, Netherlands 14.0%, Sweden 12.4%, Spain 11.8%, New Zealand 10.6%. Australia 6.8%, (Inglehart et al., 2014). This contrasts with studies of sub-Saharan Africa where the equivalent values range from 8%-62% for men, and 28-74% for women (García-Moreno et al., 2005).

1.5 THESIS OBJECTIVES

The overall aim of this thesis is to gain insights into the persistence of FGC and IPV in current populations. The focus on the persistence rather than the origins is an important distinction, particularly in relation to FGC. The earliest written observations of FGC were recorded in Ancient Egypt in 5th century BC and researchers speculate that FGC originated in North Africa (reviewed in (Lightfoot-Klein, 1989;Mackie, 1996)). However, the original motivations for FGC, and the drivers behind the subsequent spread of the behaviour which resulted in the current global FGC distribution, are unknown. Likewise, FGC cannot be assumed to be a generations old tradition in all communities and there are documented examples of communities adopting the practice within living memory (Leonard, 2000a;Dellenborg, 2004). Framing behaviours as long-standing traditions may be used to explain or justify their existence even if the behaviour is actually relatively new (Dellenborg, 2014; Crandall et al., 2009).

This thesis has three key objectives which are addressed in each of the research chapters to differing degrees. Specific research questions that are addressed within the research chapters regarding FGC and IPV are outlined in Section 3.5 and Section 4.5.

Objective 1: To further understanding of IPV perpetration and FGC persistence

Studies have revealed a variety of risk factors that increase the odds of IPV occurring (Heise and Kotsadam, 2015), and that influence parents in their decision to have their daughters cut (Sipsma et al., 2012;UNICEF, 2013). However, many questions remain concerning the reasons why these behaviours are prevalent despite the harm that they cause. For example, there is little understanding about the influence of community and social factors on either behaviour, or about the motivations behind the different types of IPV. Fully understanding the drivers for both behaviours are necessary steps towards being able to plan effective policies aimed at behavioural change (WHO, 2011;Fulu et al., 2014).

Objective 2: To understand the extent to which evolutionary theory can be used to explain IPV and FGC

Applying evolutionary anthropology to human behaviour is a promising field of research (Gibson and Lawson, 2014). An increasing number of studies have demonstrated that this approach can reveal previously unrecognised motivations for specific harmful cultural practices (e.g. Lawson et al., 2015;Schaffnit et al., 2019b) which are discussed further in Section 2.5. However, it is also recognised that there are limits on the extent to which ultimate drivers can explain human behaviour, and that proximate cultural and social influences will also be important (discussed in Section 2.2) (Tinbergen, 1963;Mesoudi, 2011b;Nettle et al., 2013;Mace, 2014). Testing ultimate and proximate causes of FGC and IPV presents an opportunity to uncover motivations for these behaviours which have not been considered in the literature to date. This study continues the line of research testing the validity of an evolutionary approach in explaining human behaviours, particularly those evolutionary puzzles which do not appear to be enhancing individual fitness (Cronk, 1991;Winterhalder and Smith, 2000;Nettle et al., 2013;Brown and Richerson, 2014).

Objective 3: To draw out implications relevant policy work

Policy makers are struggling to identify the most effective interventions to change IPV or FGC behaviour, and there is an urgent need for a better understanding of why these two behaviours persist and how interventions will affect these behaviours (eradication strategies are evaluated in Section 3.3.3 (FGC) and Section 4.3.3 (IPV)). Primary prevention of IPV is in its very early stages and programmes aimed at behaviour change are yet to be properly evaluated (Heise, 2011;Fulu et al., 2014). FGC eradication programmes have been implemented for several years, however FGC behaviour appears resistant to change in many contexts (WHO, 2011;Johansen et al., 2013). The convergence of interests between

policy makers and evolutionary anthropologists has great potential and an important objective of this thesis is to draw out implications from the research findings which could be used to inform interventions aimed at behavioural change (Brown and Richerson, 2014;Gibson and Lawson, 2015).

A secondary objective is to test common assumptions concerning FGC and IPV (Almansa Martínez and Alcón Belchí, 2017). Both behaviours are prone to misunderstanding, and unsubstantiated statements are often made about FGC and IPV even in the rhetoric used in international conventions, particularly concerning the role of the patriarchy in maintaining both behaviours, and the consequences that FGC has on women's sexual behaviour e.g. (UN, 1995;WHO, 2012a;UN Women, 2017a). As described in Sections 1.3 and 1.4, FGC and IPV are both highly complex behaviours with great variation in their expression, and meanings can rarely be generalised across populations (Gosselin, 2000a;Gruenbaum, 2001b;Heise, 2012).

1.6 STUDY DATA

These research objectives and the specific research questions (outlined in Section 3.5 and 4.5) are addressed using secondary datasets collected by the Demographic Health Survey (DHS) from countries in sub-Saharan Africa (https://dhsprogram.com). The DHS is funded by the United States Agency for International Development and surveys are conducted in collaboration with the host government.

The DHS has developed standardised procedures, methodologies, and manuals to guide the survey process. Data collection in each country takes approximately two years. DHS surveys cover a wide range of demographic and health topics in depth, and there are also optional modules on IPV and FGC. DHS surveys collect nationally representative data at the household level, and the resulting datasets are comparable across countries with large sample sizes (on average 10,000 women and 3,000 men per country).

For this thesis the geographic area was restricted to sub-Saharan Africa based on FGC distribution. Datasets were selected for use in each research study according to specific selection criteria which are outlined in each research chapter. A summary is provided in Appendix 9.1.

The use of secondary data in evolutionary anthropology studies is becoming increasingly common and has many advantages, including the large sample sizes and the rich data which covers many variables (Nettle et al., 2013;Mattison and Sear, 2016;Rosinger and Ice, 2019). The use of secondary data analysis also carries an ethical benefit as fewer individuals are disturbed by questioning. The use of DHS data in research is well established; between 1984 to 2010, 1,117 peer-reviewed publications referenced DHS data across 232 journals (Fabic et al., 2012). The DHS data is particularly suitable for this thesis for several reasons; the DHS surveys cover both IPV and FGC behaviour and opinions, data is collected from

men and women and couples can be identified, the data is a representative sample of individuals across ethnic groups and socioeconomic profile, and the data is suitable for cross-cultural comparisons as same questionnaires are used in all countries (Rosinger and Ice, 2019).

Using secondary data does have some disadvantages. The survey questions may not always align with the research questions; therefore the research question may need to be addressed using proxy variables which are indicative of the behaviour of interest (Nettle et al., 2013;Mattison and Sear, 2016). Secondly the large sample sizes mean that in statistical analysis p values may need to be interpreted with caution (Mattison and Sear, 2016;Rosinger and Ice, 2019). Each research chapter discusses how these disadvantages are mitigated.

1.7 THESIS STRUCTURE

This is a publication-based thesis consisting of 4 theoretical and background chapters, 4 research chapters, and a discussion chapter. Two of the research chapters have been published while the other 2 will be submitted for publication in the coming months. The research chapters are written to comply with the themes and formats of the relevant peer-reviewed journals.

Chapters 1-4 comprise the introductory section, Chapters 5-8 comprise the research chapters, and Chapter 9 is a full discussion.

Chapters 1-4 Introductory Section

Chapter 2 discusses how an evolutionary approach can be used to understand human behaviours. The key evolutionary theories relevant to the research question are described, and examples of how these theories have been applied to human behaviour are discussed. Evolutionary anthropology is described, including the subdisciplines of human behavioural ecology and cultural evolution, and the evolutionary anthropological approach is discussed in relation to other harmful practices, justifying the approach which is used in research chapters 5, 6 and 7.

Chapter 3 and Chapter 4 provide context for the research chapters that follow. Some historical context is given on how the behaviours have been studied, including the contributions by anthropologists. International activism directed towards either behaviour is described, and the controversies are outlined. The different theoretical frameworks that have been proposed to understand either practice are presented, including evolutionary frameworks, followed by an evaluation of the eradication programmes that have been implemented to date. The chapters each end with the specific research questions relating to either behaviour that will be addressed within the thesis.

Chapter 5: Is there a link between paternity concern and female genital cutting in West Africa?

This chapter, co-authored with Mhairi A. Gibson and published in *Evolution and Human Behaviour* (Howard and Gibson, 2019) examines the evolutionary drivers which might result in a preference for marriage to women with FGC, which in turn could perpetuate FGC by encouraging parents to have their daughters cut to ensure their marriageability. Preserving premarital virginity and controlling women's sexual urges are two explanations given by some practising communities for FGC, and FGC can be a prerequisite for marriage (Dorkenoo, 1994;Adongo et al., 1998;Toubia and Sharief, 2003;Berg and Denison, 2013). An evolutionary interpretation is that marriage to women with FGC might provide men with evolutionary fitness benefits via enhanced paternity certainty (Hartung et al., 1976). Thus, paternity concern is proposed as one of the evolutionary drivers behind the persistence of FGC, although this has not been tested empirically (Van Rossem and Gage, 2009;Onyishi et al., 2016). To address this question, three assumptions implicit in the paternity certainty theory were tested; whether women with FGC are less likely to have extra-pair sex; whether women with FGC marry earlier than women without FGC; and whether the perceived risk of higher non-paternity affects male marriage preferences for women with or without FGC. This study used DHS data from five West African countries (n10,695 couples).

Chapter 6: Frequency-dependent female genital cutting behaviour confers evolutionary fitness benefits

This chapter, also co-authored with Mhairi A. Gibson, published in *Nature Ecology & Evolution* (Howard and Gibson, 2017) examined the genetic and cultural influences which might influence the persistence of FGC practices. Cultural evolutionary theories of frequency-dependent learning predict that individuals will adopt a behaviour based on how common it is in their reference group (Boyd and Richerson, 1985;Efferson et al., 2008). Evolutionary theory predicts that individuals will react adaptively to their context, optimising their evolutionary fitness (Cronk, 1991;Laland and Brown, 2011). The analysis in this chapter firstly tested the social transmission of FGC, and how parents' decision to have their daughters undergo FGC may be influenced by the FGC behaviour of the people surrounding them. Secondly, the analysis tested the effect of frequency-dependent behaviour on women's reproductive success, depending on their FGC status. This study used DHS data from five West African countries (n10,067 women).

Chapter 7: Can evolutionary sexual conflict help to explain patterns of male-to-female IPV?

This chapter uses a sexual conflict framework to examine IPV and tests the proposal that men may gain evolutionary benefits through IPV perpetration. In an evolutionary context, the term sexual conflict is used to describe the conflict resulting from the differing evolutionary goals that men and women may have due to their fundamental biological differences (Bateman, 1948). Accordingly men may have a

higher optimal reproductive rate than women and are therefore motivated to father more children, whereas women are limited in the number of children they can bear, so instead seek to optimise their fitness by securing paternal investment and 'high quality' partners (Dawkins, 1976;Parker, 1979; Borgerhoff Mulder and Rauch, 2009).

It is proposed that these conflicting evolutionary priorities might trigger IPV in certain circumstances. Firstly, men may use IPV to coerce their wives to have more children (reproductive coercion) (Miller et al., 2010), secondly, women may object to their husbands pursuing reproductive opportunities outside the marriage (e.g. extra-pair sex, or polygamy) which could result in IPV (termed 'paternal disinvestment') (Stieglitz et al., 2011), and thirdly, men may use IPV to protect their paternity in response to their wives' actual or potential extra-pair sex (paternity concern) (Buss and Duntley, 2011). These proposals are tested using DHS data from 12 sub-Saharan African countries, examining physical IPV and sexual IPV separately (n 25,577 couples).

Chapter 8: Testing for an association between FGC and IPV in six countries in sub-Saharan Africa

The research in this chapter tests whether there is an association between FGC status and women's IPV experience. Both behaviours are included under the definition of violence against women and girls (VAWG) and there is an expectation that different types of VAWG are associated (UN General Assembly, 1993). At the individual level it has been found that women who experienced adverse childhood experiences are more likely to experience IPV in adulthood, known as re-victimisation (Messman and Long, 1996). At a societal level, it is asserted that IPV and FGC are both explained by patriarchal values and gender imbalance (Smith, 1990;Gruenbaum, 2001a). Consequently, a recent UN policy note encourages strengthening policy linkages between FGC and IPV programme work (UN Women, 2017a;UN Women, 2017b). However, the UN policy note also acknowledges gaps in the literature concerning the correlated prevalence of these two behaviours. These research gaps are addressed in this chapter using DHS data from 6 sub-Saharan Africa countries (n33,689 women).

Chapter 9: Discussion

In Chapter 9 the research findings from each chapter are discussed in more depth, drawing together common themes and highlighting the implications of the findings in relation to the research objectives. Novel contributions to the literature concerning the persistence of FGC and perpetration of IPV are discussed in further detail. Additionally, the application of an evolutionary anthropological approach to understand these two behaviours is evaluated, and the findings which have implications relevant to policy and programme work are considered. The chapter ends with a discussion of some outstanding questions that warrant further research.

CHAPTER 2 APPLYING AN EVOLUTIONARY ANTHROPOLOGICAL APPROACH TO HUMAN BEHAVIOUR

2.1 INTRODUCTION

This chapter outlines how an evolutionary approach can be applied to understanding human behaviour. The key evolutionary theories relevant to the research questions of this thesis are summarised and illustrated with examples of how these theories have been applied to human behaviour. This is followed by an explanation of evolutionary anthropology which also outlines the disciplines of human behavioural ecology and cultural evolution, and their different approach to understanding fitness-limiting behaviours. Finally, examples of how an evolutionary anthropological approach has been used to address harmful practices are given, justifying this as a useful approach to apply to FGC and IPV behaviour.

2.2 PROXIMATE AND ULTIMATE LEVELS OF EXPLANATION

As first identified by Mayr and further developed by Tinbergen, there are four different questions that can be asked when trying to understand why an individual performs a behaviour (Mayr, 1961;Tinbergen, 1963). These questions concern the immediate cause of the behaviour (proximate cause), the adaptive value of the behaviour (ultimate cause), the developmental learning of the behaviour (ontogenetic cause), and the evolutionary history of the behaviour (phylogenetic cause). Behaviours will have complementary or non-competing explanations at all four levels. Ultimate and proximate causes of behaviour are most relevant to the research questions within this thesis.

Ultimate causes of behaviour are addressed using Darwinian evolutionary principles (Section 2.3), examining the effect that a behaviour might have on an individual's evolutionary fitness. Proximate causes of human behaviour can include physiological, psychological and cultural mechanisms (Cronk, 1991). Proximate causes relevant to the themes of this thesis are provided by cultural evolutionary theories of social transmission (see section 2.4.2), and by social theories for behaviour (discussed Section 3.2 and Section 4.2). The ultimate-proximate dichotomy clarifies how the same behaviour can be explained by both proximate and ultimate level explanations. However, there is overlap between the two levels meaning that the level of causation may not always be clearly differentiated. The context that individuals are responding to is often social, and proximate causes of behaviour create the social context which provides cues for ultimate behaviours (Scott-Phillips et al., 2011). It can also be difficult to identify whether a certain behaviour has an ultimate or proximate driver, as the same factor may trigger both an ultimate fitness enhancing response as well as a proximate response (Laland et al., 2011).

However, Tinbergen's framework is particularly helpful in understanding the varied explanations given for FGC and IPV by researchers from different disciplines. Apparently conflicting theoretical explanations can be distinguished by which level of behaviour they are explaining, allowing for complementary explanations for either behaviour at any of the four different levels.

2.3 EVOLUTIONARY THEORY

Darwin's theory of evolution by natural selection forms the basis of all evolutionary theory and explains how individuals are selected to behave in a way that will optimise their own survival and reproductive success (Darwin, 1859). Evolutionary processes act on an individual's behaviour which results in changes in gene frequencies in the population gene pool of future generations (Dawkins, 1976). Part of the variation in an individual's phenotype (behaviour, morphology and/or physiological traits) will be inherited by their offspring, and individuals with a phenotypic advantage who can compete more effectively, or who are better adapted to the environment in which they are living, will leave more offspring than others. Individuals who produce more offspring, passing more genes to future generations' gene pools, are said to have higher reproductive success or evolutionary fitness (Darwin, 1859).

Further evolutionary theories have been developed based on the principles of natural selection, and observations of animal behaviour. The key evolutionary theories drawn upon in this thesis are summarised below, this is not a comprehensive list of all evolutionary theory.

2.3.1 Kin selection and Inclusive fitness

The theory of kin selection recognises direct and indirect components in the process of natural selection (Maynard Smith, 1964). Individuals can pass their genes to subsequent generations directly through their own offspring, or indirectly through the reproductive success of related individuals. An individual's total evolutionary fitness, or inclusive fitness, is therefore made up of two components, their direct and indirect fitness (Hamilton, 1964). Hamilton's rule predicts that individuals will act altruistically towards their relatives, where the degree of relatedness and the fitness benefit gained outweighs any cost they may experience (Hamilton, 1964).

Kin selection provides the basis for understanding cooperative breeding in humans, and Hamilton's rule has been demonstrated in human behaviour in numerous ways, showing how individuals show favour towards close kin over more distant relatives. For example, kin selection theory may explain why the amount of time adults invest in childcare of their indirect relatives varies according to their relatedness (Hames, 1988), why people bequeath their estate in their wills in proportion to the relatedness of their relatives (Smith et al., 1987), why people tend to cooperate with more closely related individuals

(Morgan, 1979) and why people are more attentive to close kin members' sexual relationships as a greater indirect fitness benefit is at stake (Faulkner and Schaller, 2007).

2.3.2 Parental investment, paternity certainty, and parent-offspring conflict

Parental investment is defined as 'any investment by the parent in an individual offspring that increases the offspring's chance of surviving' (Trivers, 1974). By increasing their offspring's chance of survival, parents also gain genetic pay-offs, and thereby increase their own inclusive fitness (Trivers, 1972). However, parental investment comes at a cost, as it reduces a parent's ability to invest in further offspring, as recognised by Trivers in his theory of parent-offspring conflict (Trivers, 1974). Parent-offspring conflict theory suggests that the relatedness of parents, offspring and their siblings explains why parents are selected to invest equally in all their offspring (since they are equally related to them) but that offspring are selected to compete for greater parental investment. Weaning conflicts are the classic example in mammals, where the weanling objects when a mother diverts her investment (nursing and time) from a weanling to the new offspring (Trivers, 1974).

The cornerstone of parental investment is the relatedness between a parent and their offspring. It is worth parents bearing considerable cost by investing in their offspring as they share 50% of each parent's genes (Dawkins, 1976b). However, in mammals, relatedness is certain for mothers, but fathers can never be certain of their paternity due to the mechanics of internal conception and lengthy gestation. This is particularly problematic in the estimated 5% of mammalian species (including humans), in which males are involved in parental care (Clutton-Brock, 1991). Males face the risk of wasting parental investment in non-genetic offspring which provides no fitness benefit and reduces fitness if their investment could otherwise have been placed in related offspring (Krebs and Davies, 2012). The potential paternity uncertainty faced by males, particularly in socially monogamous species, is proposed as an explanation for a number of male behaviours which may reduce non-paternity rates, including mate guarding behaviours, sexual coercion and infanticide (Smuts and Smuts, 1993;Krebs and Davies, 2012).

As a long-term pair bonding species, paternity concern has also been put forward as a driver of certain human male behaviours (Marlowe, 2000;Dickemann et al., 1981;Hartung, 1985). Examples include male sexual jealousy, mate guarding, controlling and coercive behaviours (Geary, 2005). Women may also gain benefits from behaviours which give their male partners greater assurance of their paternity, and thereby result in either increased paternal investment or preventing their offspring from being targeted for infanticide or abuse (Dickemann et al., 1981). The social framework of human societies is predicted to influence the importance placed on paternal investment, and hence, the concern that men demonstrate about their paternity. For example, in matrilineal systems in which paternal investment is

low, and women rely on their matrikin for support with childcare, it is predicted that behaviours based on paternity concern, such as infanticide, will be less common (Hartung, 1985).

2.3.3 Sexual selection; sexual competition and sexual conflict

Sexual selection is a mode of natural selection which arises due to competition for mates or matings and the differential reproductive success that males or females gain through mating behaviour (Andersson and Iwasa, 1996;Krebs and Davies, 2009). Traits which give individual males or females a mating advantage in this context will be selected for and become more prevalent within the population. This was first described by Darwin to explain the presence of apparently non-adaptive features, such as the peacock's tail feathers (Darwin, 1871). Theorists proposed that males have their reproductive success limited by their ability to fertilise females, whereas female reproductive success is limited by their lower reproductive potential and higher parental investment (Bateman, 1948;Parker, 1979). However, it is now recognised that the sex roles can vary within species, determined by the operational sex ratio, as well as between species (Owens and Thompson, 1994;Clutton-Brock, 2007;Edward and Chapman, 2011). Sexual selection theory recognises two interlinked elements explained by sexual competition and sexual conflict.

Sexual competition arises due to differences in mating success and opportunities between males and females. In species in which females invest most in offspring, there is competition between males for the opportunity to mate with females (known as intrasexual competition) (Clutton-Brock, 2007). This typically manifests in physical contests between males to assert dominance and is thought to have resulted in the evolution of a tremendous diversity of weapons across taxa, including spurs, tusks, antlers, horns, and mandibles (Krebs and Davies, 2012). There is also competition between the sexes for mating opportunities (known as intersexual competition). In species in which females invest most in offspring, females exert choice as their reproductive success is dependent on mating with high quality males, while males try to attract females for mating opportunities (Trivers, 1972;Krebs and Davies, 2012). Intersexual competition is thought to explain sexual dimorphism and the development of numerous secondary sexual characteristics such as peacock feathers, lions' manes and mating calls which are used to attract females. Sexual dimorphism may also be the result of natural selection acting differentially on either sex in the absence of sexual selection, with each sex achieving a locally optimum phenotype (Lande, 1980). Both sexes may demonstrate inter- and intra-sexual competition, and the dynamics of sexual competition are also known to be affected by ecological factors such as the operational sex ratio and resource availability (Clutton-Brock, 2007;Krebs and Davies, 2012).

Mate choice has been recognised as an important element of intersexual competition, whereby individuals assess the genetic quality of their potential mates to ensure that their offspring benefit from

the highest possible genetic quality (Andersson and Simmons, 2006). Zahavi's handicap principle proposes that traits which hinder an individual's ability to survive are selected for by mates. Importantly such traits are an honest signal of good genes, as only high quality individuals can bear the cost of the exaggerated trait (Zahavi, 1975). Accordingly, many secondary sexual characteristics may have evolved to demonstrate quality to potential mates, even those which are apparently fitness-limiting. This idea has been further developed by Grafen's theory which sets out three main criteria for costly signalling to apply; firstly the trait reduces potential fitness, secondly the trait must be a reliable indicator of genetic condition and thirdly the trait is visible or advertised to the selecting sex (Zahavi, 1975;Grafen, 1990). Signalling theory has been developed and applied to behavioural and physical traits of numerous species (Zahavi and Zahavi, 1999). Although signalling theory has been widely accepted, there are criticisms relating to the ability to measure the costliness of a trait and demonstrate this theory empirically e.g. (Kotiaho, 2001).

Sexual conflict is the other element of evolution by sexual selection. This proposes that although males and females are reliant on each other for reproduction, they pursue different mating strategies due to fundamental biological differences. Conflict arises between the sexes due to differences in their evolutionary interests, particularly when the optimal value of a trait differs for each sex (Parker, 2006). In species in which females invest most parental care male strategies favour multiple matings to achieve their higher reproductive potential (Bateman, 1948). In the same species female strategies are aimed at securing paternal investment in order to increase offspring survival, although females may also seek multiple matings to increase the chance of mating with higher quality males as well as ensuring fertilisation (Dawkins, 1976;Parker, 1979). This conflict of evolutionary interests is proposed to result in the co-evolution of strategies and counter strategies by males and females trying to achieve their own reproductive goals (Trivers, 1972).

The ecological context is predicted to affect the strength of conflict, including the availability of alternative mates, resource availability, as well as species-specific traits such as the period of infant dependency (Clutton-Brock, 2007;Krebs and Davies, 2012). Examples of sexual conflict in the animal kingdom often come from invertebrate studies under artificial selection conditions. Numerous morphological adaptations such as toxic semen, genital adaptations, grasping mechanisms and sperm competition are thought to be products of sexual conflict (Arnqvist and Rowe, 2013). In non-human primates the examples most commonly cited relate to sexual coercion by males, and infanticide, where males are thought to kill infants in order to return females back to oestrus to mate with them (Smuts and Smuts, 1993;Palombit, 2012).

In humans, intersexual competition and the theory of costly signalling has been applied to explain instances of men 'showing off' in a way that appears to jeopardise their fitness but may increase their

mating success. It is anticipated that men will proceed with such behaviours where the potential fitness benefits outweigh the potential fitness costs. Examples include particularly dangerous or high-intensity foraging strategies such as turtle hunting and spearfishing (Sosis, 2000;Bird et al., 2001;Smith et al., 2003), men's financial generosity in front of women (Iredale et al., 2008), and men's conspicuous consumption and benevolence in dating contexts (Griskevicius et al., 2007). Intersexual competition has also been applied to group cooperation and religion where costly and time-consuming behaviours and rituals may be interpreted as indicators of honest signals of commitment to the group, although others argue this may be linked to group solidarity rather than sexual competition (Irons, 2001;Gintis et al., 2001;Soler, 2012).

Some evolutionary researchers emphasise sex roles in humans and aim to demonstrate how men and women exploit each other's reproductive investment in order to secure their own fitness optima (Camilleri and Quinsey, 2012). However recently the applicability of Bateman's principle to humans has been questioned due to the cooperative nature of human parental care and pair bonding (Brown et al., 2009;Moya et al., 2016). Evolutionary anthropologists emphasise the plasticity of human behaviour and reject the idea of rigid sex roles for men and women, suggesting instead that individuals will adopt optimal behaviours depending on the context in which they are living. Sex ratios, kinship systems, religion, gender roles, paternal expectations and cultural sexual sanctions on women are predicted to affect the strength of sexual conflict experienced by men and women (Borgerhoff Mulder and Rauch, 2009).

2.3.4 Cooperation and game theory

Kin selection theory (Section 2.3.1) and parental investment (Section 2.3.2) explain the dynamics and fitness consequences of interactions between related individuals. Game theory models are used to understand how the fitness consequences of interactions between unrelated individuals may have influenced the evolution of behaviour (Smith, 1979). Game theory models consider situations in which the fitness costs and benefits resulting from an individual's behaviour depend on their own strategy, as well as the strategies of the other individuals involved, potentially over multiple interactions over generational or evolutionary time (Axelrod and Dion, 1988). Modelling is shown to lead to stable pay-off equilibriums for cooperation and altruism.

One strategy of cooperation revealed by game theory modelling is known as the evolutionary stable strategy, which is defined as a strategy that cannot be displaced by or invaded by any alternative strategy once it dominates a population (Maynard Smith and Price, 1973;Maynard Smith, 1982). Other game theory models reveal the outcome of different strategies which vary by the hypothetical situation and the frequency of interactions between individuals (Smith, 1979). How reflective these models are of

real-life scenarios have been queried, where interactions may happen sequentially rather than simultaneously, and where other sensory cues may influence behaviour. However, most agree that game theory provides a useful theoretical framework for understanding the evolution of biological interactions (Boyd, 1988). Game theories tend to be used in modelling of human behaviour, or in laboratory-based experiments, rather than being tested on empirical data. However, game theory has been applied to both FGC (Mackie, 1996) and IPV (Jones and Ferguson, 2009) described further in Section 3.2.3 and Section 4.2.8.

2.4 OVERVIEW OF EVOLUTIONARY ANTHOPOLOGY

Evolutionary anthropology is founded on the basic Darwinian principles of evolution described above. It is a loosely defined paradigm which uses evolutionary principles to understand human behaviour, biology, cognition and culture. Evolutionary anthropology applies an evolutionary approach to all anthropological disciplines including archaeology, palaeoanthropology, biological anthropology, cultural anthropology and linguistics, and also draws on other disciplines such as demography, epidemiology and economics. New disciplines have been formed; most relevant to this thesis are human behavioural ecology which applies the principles of evolutionary theory and optimization to the study of human behaviour (Cronk, 1991) (Section 2.4.1), and cultural evolution which seeks to understand with how culture evolves over time (Boyd and Richerson, 1985) (Section 2.4.2).

Although not typically included within the evolutionary anthropology paradigm, evolutionary psychology also applies evolutionary theory to human behaviour. Evolutionary psychology is based on the premise that psychological adaptations evolved in reaction to selection pressures in human ancestral environments (Laland and Brown, 2011). Evolutionary psychology studies seek to understand a universal human nature resulting from this evolutionary process in the past. There is an expectation that contemporary populations may not be well adapted to current environments (Tooby and Cosmides, 2005). This contrasts with evolutionary anthropology which is specifically concerned with the plasticity of human behaviour in relation to their environment (Cronk, 1991).

2.4.1 Human behavioural Ecology

Behavioural ecology investigates the evolutionary basis of animal behaviour due to ecological pressures, and is based on a premise of optimality models (Krebs and Davies, 2012). Human behavioural ecology tests whether these principles can be applied to human behaviour, and predicts that ‘humans are selected to optimise their lifetime reproductive success in response to environmental conditions by flexibly altering their behaviour’ (Laland and Brown, 2011). The understanding of environmental conditions referred to in human behavioural ecology is very broad and includes an individual’s physical, social and cultural context (Nettle et al., 2013). Due to the difficulties in measuring lifetime reproductive

success in humans, proxies are often used in human behavioural ecology studies, such as the number of surviving offspring, the interbirth interval, mating success, energetic return, or behaviours indicative of evolutionary concerns (Nettle et al., 2013;Mattison and Sear, 2016).

Human behavioural ecology theories predict that individuals will make context-dependent fitness optimising decisions. However, this does not imply that individuals make complex fitness calculations at each key moment, or that they are conscious of the fitness outcomes. Rather, the assumption is that individuals will behave in a way that will maximise their fitness, according to a pre-programmed 'rule of thumb' (Barrett et al., 2002). This approach is often referred to as playing the phenotypic gambit, in other words, focussing on the outcomes of behaviour rather than being concerned with the underlying genetic, cultural, cognitive or phylogenetic mechanisms (Grafen, 1984).

2.4.2 Cultural evolution

Theories of cultural evolution seek to explain the transmission of behaviours between individuals or groups of individuals, with the result that behaviours may be maintained at a constant level, or become more or less widespread in a population over time (Boyd and Richerson, 1985;Richerson and Boyd, 2008;Mesoudi, 2011b). Transmission mechanisms, also known as learning biases or social learning strategies, are different ways in which behaviours may be transmitted between individuals, for example copying successful individuals (prestige bias), or copying in proportion to how common a behaviour is in the group (frequency-dependent bias) (Boyd and Richerson, 1985).

Frequency-dependent bias is particularly relevant to this thesis, tested in Chapter 6. Modelling has shown that frequency-dependent bias can be weak, linear or strong, depending on whether the frequency of the behaviour is gradually declining, remaining constant, or gradually increasing within the group. Strong frequency-dependent bias where individuals are disproportionately likely to adopt the behaviour, also known as conformity bias, is often put forward as an explanation for how neutral or maladaptive behaviours become commonplace. This is because frequency-dependent behaviours are adopted based on frequency without evaluation of merit (Boyd and Richerson, 1985;Efferson et al., 2008).

The process of cultural change over time has similarities with genetic evolution whereby favourable variants are selectively retained and transmitted, and cultural transmission is affected by non-selective processes akin to drift and migration (Cavalli-Sforza, 1981;Boyd and Richerson, 1985). However, there are important differences between genetic and cultural evolution. The rate of change can be much faster as cultural transmission does not rely on reproduction; inheritance is not necessarily vertical and there are many potential transmission pathways, for example transmission can be between unrelated members of the same generation, or between unrelated members of different generations, or between

related individuals; and transmission can also occur one-to-one or one-to-many (Mesoudi, 2011b). While human behavioural ecology has a predictable measurable framework using optimisation models and fitness outcomes, cultural evolution does not have an overriding prediction because the details of how transmission occurs and the nature of the behaviour in question will result in differing outcomes (West and Burton-Chellew, 2013).

Cultural transmission of behaviour has been tested in some recent empirical studies. Two examples concern culturally acquired food avoidances and preferences in Fiji. One study examined food avoidances during pregnancy and breastfeeding, finding evidence that these are culturally acquired through a combination of familial transmission and selective learning from prestigious individuals, and further that they were adaptive as they significantly reduced the chance of food poisoning (Henrich and Henrich, 2010). The authors claim these taboos were not acquired by direct experience or environmental circumstances although there is no examination of the women's social and ecological circumstances. A further study in Fiji examined learning biases in relation to food and medicinal plants and found evidence of prestige bias, where individuals were more likely to learn from successful individuals, which is presented as an adaptive strategy (Henrich and Broesch, 2011). In a different area, language use has been addressed using cultural evolutionary theory and a recent study demonstrated how frequency-dependent bias determines why certain words are used more than others where multiple options are available (Pagel et al., 2019).

The interaction between cultural and genetic drivers of human behaviour is subject to longstanding debate, and has been conceived in different ways (Mace, 2014). Most theorists recognise that their interaction is likely to result in novel patterns of selection which could provide a deeper understanding of departures from fitness optima, as cultural transmission allows the spread of traits which are not fitness enhancing (Boyd and Richerson, 1985;Laland et al., 2011;Brown, 2012). However some researchers consider cultural transmission to be akin to any other proximate mechanism, i.e. one which influences context but does not influence adaptive change (Nettle et al., 2013), while others consider cultural evolution as a 'transformational force' of human evolution and emphasise the role that cultural evolution can play in shaping genetic evolution (Borgerhoff Mulder and Schacht, 2012;Brown and Richerson, 2014;Mesoudi et al., 2013). This relationship has also been conceptualised as gene-culture coevolution and niche construction, both of which consider the interaction of genes and culture over long time periods (Laland et al., 1999;Laland et al., 2010;Richerson et al., 2010). Examples of gene-culture co-evolution include the distribution and frequency of lactose intolerance and sickle cell mutations (Wiesenfeld, 1967;Feldman and Laland, 1996).

2.4.3 Behaviours which appear to limit evolutionary fitness

As this thesis is concerned with two behaviours which appear to be fitness-limiting, it is relevant to discuss the different theoretical approaches taken by human behavioural ecology and cultural evolutionary theorists to understanding the existence and persistence of apparently fitness-limiting behaviours. Examples include celibacy and the demographic transition to a smaller family size, as well as behaviours which appear overtly harmful and fitness reducing such as IPV and FGC. Such behaviours may also be referred to as costly or maladaptive, although without knowing the fitness consequences of a behaviour, these terms are used with caution (Borgerhoff Mulder, 1991).

Human behavioural ecologists anticipate that human behaviour is adaptive and fitness-optimising (Brown and Richerson, 2014), and there is a precedent of studies which demonstrate that a careful examination of fitness costs and benefits can reveal that behaviours which were initially thought to be fitness-limiting, may be adaptive in certain contexts, for example early marriage (Allal et al., 2004;Nettle et al., 2011) and polygamy (Gibson and Mace, 2007;Lawson et al., 2015) (discussed in Section 2.5). Human behavioural ecology's assertion that behaviour is adaptive is a source of criticism (Logan and Qirko, 1996), especially in view of many as yet unsolved 'Darwinian puzzles' (Brown and Richerson, 2014). There are some theoretical concessions that human behavioural ecologists do make to the possibility of fitness-limiting behaviour. For example it is possible that these behaviours may not yet be 'fixed' in the population and that given time will be replaced with adaptive alternatives (Turke, 1990), or that there may be maladaptive side effects to otherwise adaptive solutions (Betzig, 1989), or there may be genetic or developmental constraints which prevent humans from achieving maximum fitness under all circumstances (Laland and Brown, 2011). Many human behavioural ecologists also recognise that cultural transmission could result in maladaptive responses (Brown and Richerson, 2014). Further, others argue that individual behaviour may be primed to maximise non-genetic currencies such as reputation and prestige after death, which could be detrimental to maximising genetic fitness (Wells and Strickland, 2006).

Cultural evolutionary theory does not predict that behaviours will be adaptive, although there is an assumption that cultural evolutionary processes will tend to result in behaviours that increase fitness (Richerson and Boyd, 2008). Some transmission mechanisms are thought more likely to lead to fitness-enhancing behaviours, in particular those which involve an individual choosing or learning a behaviour and potentially modifying it slightly, based on their own experience or knowledge. However, other transmission mechanisms theoretically could lead to widespread adoption of maladaptive behaviours, particularly mechanisms where the behaviour of others influence which trait an individual adopts (Boyd and Richerson, 1985). Frequency-dependent transmission (conformity bias) is often put forward as an explanation for how neutral or maladaptive behaviours become commonplace, as behaviours are

adopted based on frequency without evaluation of merit (Boyd and Richerson, 1985). It is argued that the desire or predisposition to conform is a shared or universal human trait, and that there is often a danger in non-conforming and being discriminated against by the group (Cavalli-Sforza, 1981).

Cultural evolutionary theorists also predict that it is more likely that a maladaptive trait will be transmitted horizontally between peers (who share no genes) or obliquely from older generation to the younger generation, for example teachers to pupil (who again, share no genes) than transmitted vertically from parents to offspring (who do share genes) (Smith and Winterhalder, 1992). This is because unrelated individuals have no inclusive fitness at stake, so fitness consequences would be no concern (Mesoudi, 2011b). As an example, prestige bias is presented as a possible explanation for the demographic transition; people with small families attain higher status as they have more time to do so, and others copy these higher status individuals due to prestige bias, and thus having a small family becomes a social norm spreading across a population (Mesoudi, 2011b).

There are many examples of cultural evolution models showing how cultural traits can be spread in the face of a fitness disadvantage, (Cavalli-Sforza, 1981;Boyd and Richerson, 1985;Richerson and Boyd, 2008). Copycat suicide has been modelled using cultural evolutionary theory, looking at how suicide may be learned or copied using modelling simulations (Mesoudi, 2009). The author suggests that prestige bias and the one-to-many transmission characterised by mass media could explain how celebrity suicides generate mass clusters of copycat suicides. Another study has examined the persistent use of complementary medicine in Western populations, which could have negative health consequences if used in place of a more effective bio-medical alternative (Tanaka et al., 2009). Modelling showed that 'purely superstitious remedies' spread more readily amongst a population under certain conditions. This was particularly the case where the very ineffectiveness of these remedies meant they were used for longer, and therefore gained more converts. Cultural evolutionary studies demonstrating maladaptive behaviours which use empirical data are less common (Aunger, 1994).

2.5 APPLICATION OF EVOLUTIONARY ANTHROPOLOGY TO HARMFUL PRACTICES

Evolutionary anthropology approach has been applied to a wide variety of human behaviours which include foraging division of labour between men and women, how and why individuals share resources with kin and non-kin, factors that determine when individuals start to reproduce, family planning decisions, and who contributes towards childcare (reviewed in Nettle et al., 2013).

Increasingly this approach is being applied to understanding issues of public health, including harmful practices (Gibson and Lawson, 2014). Evolutionary models predict that behaviours that are detrimental to well-being may be maintained in a population provided they lead to higher fitness (Hill, 1993). Understanding why a behaviour exists and persists is the first step in being able to take steps to change

that behaviour. The interaction of interests between evolutionary anthropology and international development priorities has potential to inform policy and programme work (Gibson and Mace, 2006;Shenk, 2007;Gibson and Gurmu, 2011). An evolutionary anthropology approach often challenges the validity of universal policies and stresses the importance of examining and addressing behaviours in their context (Gibson and Lawson, 2015).

Despite these potential benefits, the concept of applying evolutionary theory to human behaviour can be challenging. While it is readily accepted that non-human animals may have instincts or behaviours which conform to the evolutionary theories outlined above, the proposal that human behaviour is motivated by fitness optimisation is controversial. This is particularly the case when there is a moral reaction to the behaviours in question, or when the behaviours appear to be causing pain and suffering, as is the case with FGC and IPV.

The discomfort around applying evolutionary theory to human behaviour may be due to misunderstandings over the concept of evolutionary fitness, which may be interpreted as equivalent to health or physical fitness. It is important to stress that evaluation or measurement of evolutionary fitness carries no assumption of a positive effect on health or well-being, and no value judgement or justification for the behaviour in question; a fitness approach does not evaluate the merits of a behaviour in any way other than the consequences on reproductive success (Hill, 1993). Evolutionary anthropology may also be incorrectly interpreted as genetic determinism, or confused with dated concepts of sociobiology (Wilson, 1978). Other concerns come from practitioners in the international development arena who consider evolutionary drivers to be 'non-modifiable factors' and therefore not relevant to programme work (e.g. (Heise, 2011). There are also human behaviours which do not appear to result in fitness optimisation which challenge the validity of the optimisation models (discussed in 2.4.3).

An evolutionary anthropological approach has also been used to understand several seemingly fitness-limiting behaviours, which suggests that further insights can be gained by using this approach. These behaviours include non-exclusive breastfeeding as a response to parent-offspring conflict (McDade, 2001;Quinlan et al., 2003), differential treatment of sons and daughters, including selective infanticide, as a response to parental condition (Trivers and Willard, 1973;Dickemann, 1979;Gaulin and Robbins, 1991;Hopcroft, 2005), and dowry practices as a form of daughter bias (Shenk, 2007). Below, an evolutionary approach to understanding two further behaviours, which are also targeted for eradication by the United Nation's Sustainable Development Goals, are discussed in more detail (UN, 2016) (discussed in Section 1.2). Evolutionary anthropology is discussed in relation to FGC and IPV in Sections 3.2.4 and 4.2.8.

2.5.1 Polygamous marriage

Polygamous marriage is considered a harmful cultural practice by the UN and WHO due to poor child health outcomes observed in polygamous households (Strassmann, 1997;Sellen, 1999;Hadley, 2005). Polygamy has been shown to increase men's reproductive success, whereas women's fitness may be reduced due to sharing household resources as well as the potentially negative consequences on their children's health (Betzig, 1986; Borgerhoff Mulder, 1987;Sellen, 1999). Evolutionary anthropology studies have shown that polygamy can be fitness enhancing for women in certain social conditions. One study has shown that the first wives of polygamously married men have higher reproductive success than monogamously married women, which is suggested to be due to the higher quality (wealth and status) of polygamously married men (Gibson and Mace, 2007). Other studies have challenged the poor health outcomes, and therefore reduced fitness, associated with polygamy; a study in the Gambia found little difference in child mortality rates between polygamous or monogamous unions (Sear et al., 2002). A further study in Tanzania showed that poor child health was found in polygamous households as they tend to be found in poorer areas, but within areas where polygamy was common, the polygamous households had better food security and child health, as measured by height for age, than monogamous households (Lawson et al., 2015). These studies deepen understanding of why polygamous marriage systems persist and the cost-benefit trade-offs individuals make in their marriage choices. These studies suggest that women pursue this seemingly fitness-limiting practice in contexts where there is an evolutionary pay-off. The impact of polygamy on child health, and the understanding of polygamy as either a harmful cultural practice or a cultural norm perpetuated by gender inequality, is an area which evolutionary anthropological research can continue to contribute towards (Lawson and Uggla, 2014).

2.5.2 Early marriage and early childbearing

Early marriage is associated with a number of humanitarian concerns such as lack of empowerment, poor mental health, diminished sexual and reproductive health, and low educational attainment (UNFPA and IPPF, 2013). Early marriage is also associated with early childbearing or adolescent pregnancy, usually defined as childbirth before the age of 18, which has been demonstrated to have serious health consequences relating to maternal and infant mortality and morbidity (WHO, 2012).

Evolutionary anthropology studies trying to understand drivers for adolescent pregnancy in the face of these health risks have examined the optimal age at first birth to achieve highest reproductive success; starting childbearing too young risks maternal and infant mortality and starting too late may reduce fertility. A study from the Gambia modelled the optimal age at first birth based on the local context and found this matched the modal age at first birth observed in the population (Allal et al., 2004). Similarly, a study of foragers in Venezuela found that the average age-at-first birth was 15.5 years which appeared to be the optimum age. Starting much younger resulted in higher firstborn infant mortality,

but delaying until over 17 did not result in higher fertility (Kramer, 2008). Both studies therefore suggest that women start reproduction around the age that will optimise fertility in their specific ecological setting.

Evolutionary anthropology studies have also considered whether early marriage might be a manifestation of parent-offspring conflict; younger girls may not have reproductive autonomy and early marriage or childbearing may result from parental pressure particularly where parents benefit financially through bridewealth payments and inclusive fitness (Trivers, 1974). However, a recent study in Tanzania found autonomy in partner choice among girls of all ages, as well as relatively higher reproductive success and status for girls who married early, which challenges the parent-offspring conflict hypothesis as well as revealing girls' motivations for early marriage (Schaffnit et al., 2019a). An alternative evolutionary approach to explaining early childbearing applies life history theory to the timing of the first reproductive event. This theory predicts that following an uncertain or stressful childhood, life events will be hastened, including a lower age-at-first birth (Hill, 1993). Some significant studies demonstrating this have used data from high income, low fertility contexts, where early childbearing or 'teenage pregnancy' goes against societal norms (Chisholm et al., 2005;Nettle, 2010;Nettle et al., 2011;Placek and Quinlan, 2012;Dickins et al., 2012). This approach has also been applied to LMIC populations (Quinlan, 2010).

2.6 CONCLUSION

This overview demonstrates the insights that can be gained from applying evolutionary theory to human behaviour. Evolutionary models predict that behaviours that are detrimental to well-being may be maintained in a population provided they lead to higher evolutionary fitness (Hill, 1993). Accordingly, an evolutionary anthropological approach is well placed to examine harmful practices, such as polygamy and early marriage, which like FGC and IPV are widespread practices and also targeted for elimination by the UN SDGs (Lawson et al., 2015;Schaffnit et al., 2019b;UN, 2016). However, by addressing ultimate rather than proximate motivations, evolutionary theory does not address the mechanisms involved (Tinbergen, 1963). The application of evolutionary theory to harmful practices must also be handled sensitively, due to potential misunderstandings over the concept of evolutionary fitness or confusion with physical fitness or health. Likewise critique from other disciplines needs to be acknowledged which concerns the application of optimisation theory without allowing for the possibility of suboptimal behaviours (Smith, 2000). However, the insights gained from research to date into other harmful practices, suggests that applying an evolutionary anthropological approach may also reveal further motivations for FGC and IPV perpetration.

CHAPTER 3 FEMALE GENITAL CUTTING: GLOBAL CONTEXT, THEORY AND INTERVENTION

This chapter gives context for the research chapters that follow. First, a discussion is given outlining the tension between international activism and the resistance from practising communities to eradication efforts, and the contributions made by anthropologists and feminist and human rights activists towards this debate. The different theories which have been put forward to explain the persistence of FGC are discussed, giving context to the evolutionary framework being used in this thesis. Finally, as the research objectives of this thesis include drawing out implications for policy and programme work, an evaluation of the eradication programmes which have been implemented to date is given. The chapter ends with the specific research questions concerning FGC that are addressed within the thesis.

3.1 INTERNATIONAL INTERVENTIONS AGAINST FGC

3.1.1 Campaigns and international action

Interventions to change FGC behaviour have been attempted since the early 20th century and have frequently been met with resistance or lack of engagement by practising communities (Wade, 2012). This interaction, which has been characterised as a tension between the local social norm of performing FGC and the international norm of not performing FGC, is still ongoing (Cloward, 2015).

The first attempts to stop FGC were made by protestant missionaries in the early 20th century (Boyle et al., 2002;Gruenbaum, 2005). Legislation was also passed against FGC by colonial governments, for example in Sudan in 1946, Egypt in 1959, and Kenya in 1956 which was famously resisted by local women who defended their right to follow their own traditions (Ladjali and Toubia, 1990;Thomas, 2000;Winterbottom et al., 2009). Coordinated global international interventions against FGC began in earnest in the 1980s following the publication of the Hosken report (Hosken, 1976;Hosken, 1979;Boyle et al., 2002). Fran Hosken, a feminist academic and journalist, collected data in 15 sub-Saharan African countries during the 1970s and the resulting report was the first to demonstrate that FGC was a widespread practice affecting millions of women, rather than a niche custom practised by a few ethnic groups (Hosken, 1979). Hosken and others were instrumental in changing attitudes towards FGC, for example introducing the now widespread term ‘female genital mutilation’, and this feminist activism is reflected in the rhetoric used in international conventions and theories put forward to explain FGC (discussed in Section 3.2.1) (Mohanty, 1984;Gosselin, 2000a;Bradley, 2015).

The World Health Organisation (WHO) had refused a request made by the UN in 1958 to study FGC because it considered FGC to be a cultural rather than a medical issue (Hosken, 1976;Gordon, 1991). However, following the Hosken report and further mobilisation, the WHO become central in the

information gathering process to document the prevalence and consequences of FGC (WHO et al., 1997). The WHO's first conference on harmful cultural practices in 1979 established the goal of FGC eradication, rather than medicalisation or reduced severity of forms (WHO, 1979;UN, 1995;Toubia and Sharief, 2003).

International eradication campaigns were met with resistance by women from practising communities who objected to the depiction of African women as 'downtrodden, forlorn, helpless casualties of male dominance' with no autonomy, and who rejected the idea of FGC as gendered oppression (Abusharaf, 2001;Wade, 2012). Key anti-FGC activists including Hosken, were boycotted at the international women's conference in 1980 in Denmark due to their perceived ethnocentric views (McChesney, 2015).

To counter this resistance, focus moved towards establishing the harm caused by FGC and applying a 'medical facts' approach to inform eradication efforts. The WHO's involvement in the late 1980s gave credibility to some of the health claims which were used in community programmes to educate people about the adverse effects of FGC (Shell-Duncan, 2008). The medical facts approach may have been successful in raising awareness, however, it was problematic for several reasons (discussed in Section 3.3.3). Not least, many practising communities were aware of the potential health risks but proceeded with FGC despite these risks because of its social and cultural importance (Obiora, 1997;Shell-Duncan and Hernlund, 2000;Gele et al., 2013).

The final shift in the global anti-FGC campaign has addressed FGC as a violation of human rights. This change reflected the involvement of African women's organisations in anti-FGC campaign, such as the Inter African Committee Against Harmful Traditional Practices. These groups were instrumental in shifting the discussion from the medical facts towards women's reproductive and human rights (Althaus, 1997). Subsequently, a number of significant steps have been taken to address FGC and violence against women, and several key international human rights statutes were passed which are legally binding for all UN member states. These include the 1989 Convention on the Rights of the Child which refers to 'abolishing traditional practices prejudicial to the health of children' (UNICEF, 1989), and the 1993 Declaration on the Elimination of Violence against Women, which refers to FGC within the definition of violence against women (UN General Assembly, 1993).

More recently the United Nation's Sustainable Development Goals set in 2015 includes a goal relating to gender equality, with a specific target relating to FGC to 'eliminate all harmful practices, such as child, early and forced marriage and female genital mutilation' discussed in (Section 1.2) (UN, 2016).

3.1.2 Contributions from Anthropologists

Anthropologists have made important contributions to the global understanding of FGC, giving voice to practising communities and revealing motives and meanings for FGC within these communities (Sarkis, 2004). The anthropological method of examining a culture by its own terms, rather than another's values, has allowed dispassionate understanding of FGC practice in many communities through participant observation, interviews, focus groups and surveys (Gruenbaum, 2005).

FGC became a focus of anthropological study in the late 1970s. Until that date the few accounts of FGC in the academic literature tended to be written by British colonial surgeons and gynaecologists, or in ethnographies which referred to FGC in relation to the role of women in society (Worsley, 1938;Mustafa, 1966). As global attention turned to FGC in the late 1970s, anthropologists started to address FGC as the primary topic of interest (Hayes, 1975;Lyons, 1981;El Dareer, 1982;Gordon, 1991). There is now a large volume of anthropological work documenting FGC in a wide variety of contexts, including several important anthologies (Gruenbaum, 2001b;Shell-Duncan and Hernlund, 2000;Hernlund and Shell-Duncan, 2007;Abusharaf, 2013).

Collectively these anthropological studies emphasise the multiplicity of meanings that FGC can have to different practising communities, as well as for the individuals within those communities (Lyons, 1981;Sarkis, 2004;Gruenbaum, 2005;Abusharaf 2013). These works dismiss single factor explanations for FGC, such as sexual control of women, and stress the complicated and varied reasons why FGC is practised (Lyons, 1981). Anthropological accounts have also emphasised the importance that FGC has in forming social and ethnic identity across practising communities (Abusharaf, 2013).

As international eradication efforts increased, the focus of some anthropologists' work changed from documenting FGC practices to gaining an understanding of resistance to change (Gruenbaum, 2005). The deeper understanding concerning the importance placed on FGC by many communities reveals why many are resistant to abandonment messages (Diop and Askew, 2006). These cultural relativist ideas are important in understanding the persistence of FGC as well as resistance to change. For example, Gosselin found that actively resisting Westernisation was a factor in the persistence of FGC in Mali (Gosselin, 2000a). Cultural relativist ideas emphasise the importance of examining FGC in the local context, as the meaning ascribed to FGC varies so widely by community.

3.1.3 Human Rights versus Cultural Rights

The human rights approach to FGC eradication and the concept of universally agreed norms has been challenged by those with more cultural relativist views who question the authority of the international community to criticise or intervene in non-Western practices based on 'universalist' thinking (Brennan,

1988;Gruenbaum, 2001b). A number of female African academics, some of whom have been cut themselves, have defended their right to practice FGC. For example, Ahmadu said that 'mounting an international campaign to coerce 80 million adult African women to give up their tradition is unjustified' (Shell-Duncan and Hernlund, 2000). Their contribution to the discussion challenges the validity of Western intervention (Ahmadu, 2000;Shell-Duncan and Hernlund, 2000;Njambi, 2004).

Comparisons have also been made between the international FGC interventions and colonialism (Abusharaf, 2000). Others have objected to the inconsistency which labels FGC as a human rights violation whereas male circumcision, or genital cosmetic surgery found in high income countries, are not (DeLaet, 2009;Johnsdotter and Essen, 2010). A more general concern relates to the mismatch between these internationally agreed priorities of FGC eradication and the priorities of the women in the target countries who are more concerned with food security and basic healthcare (Gosselin, 2000a;Shell-Duncan, 2004;LaTosky, 2015a). The tension between the universal rights approach and cultural relativism is still ongoing (Cloward, 2015).

3.2 THEORETICAL FRAMEWORKS

The variety of FGC forms and contexts in which FGC is practised suggest that generalised theoretical frameworks to explain its persistence should be made with caution (Gosselin, 2000a;Gruenbaum, 2001b). Consequently, the persistence of FGC is often explained in terms of the local beliefs sustaining the practice rather than by theoretical interpretation of these beliefs and behaviours (summarised in Section 1.3.3). The three most prominent overarching theories provide proximate level explanations for FGC perpetration; feminist theory, modernisation theory and social convention theory (Tinbergen, 1963). These are outlined below, followed by a summary of the literature which has applied evolutionary theory to examine the motivations behind FGC.

3.2.1 Feminist theory of FGC

A feminist interpretation proposes that FGC results from a patriarchal desire to suppress and control women, particularly their sexual behaviour (Mohanty, 1984;Gosselin, 2000a;Bradley, 2015). In patriarchal societies women's value relate to their ability to marry and reproduce, and beliefs that FGC preserves women's virginity before marriage and their fidelity afterwards enhances women's value, contributing towards the persistence of FGC (Dorkenoo, 1994;UN, 1995;Gruenbaum, 2001b;Mackie and LeJeune, 2009;Toubia and Sharief, 2003). In many practising communities, women are dependent on marriage for their social and material well-being, and therefore families are obliged to comply with societal expectations (Boyden et al., 2012;Berg and Underland, 2013). The role of religion and culture in promoting and sustaining the patriarchy and thus FGC is also commonly discussed (Longman and

Bradley, 2015b). Sexual control of women also resonates with patriarchal ideals of female obedience, purity, chastity and subordination (Easton et al., 2003).

However, there are several critiques of feminist theory as a general explanation for FGC. The vast majority of societies that do not practice FGC are also patriarchal, and although there is an overlap between patriarchy and FGC it is difficult to prove a causal association. Patriarchy, like FGC, is not a uniform pattern and therefore is questionable as an explanation for FGC in all circumstances (Gruenbaum, 2001a). Further, some accounts of FGC make no reference to marriageability, virginity, or male preference when explaining FGC and instead cite perceived beliefs concerning the health benefits for women, peer pressure, or following ancestral traditions (Leonard, 2000b;Shell-Duncan and Hernlund, 2000).

Another challenge to feminist theory of FGC concerns the respective roles played by men and women in enforcing FGC. In particular, this relates to the paradoxical fact that women appear to be stronger advocates of FGC than men, which is difficult to reconcile with idea of the patriarchal enforcement even if it is just 'complicit silence' (Shell-Duncan et al., 2000b;Gruenbaum, 2001b;Yoder et al., 2004;Bjälkander et al., 2012;Kaplan et al., 2013a). Some interpret women's involvement as simply a survival strategy (Candib, 1999), and Longman and Bradley point out that 'women knowingly collude with the very structures that have oppressed them … there are simply no exit options available' (Longman and Bradley, 2015a). Men's support for FGC is also unclear. Although a recent study suggests that older educated men may be hiding their support for FGC (Gibson et al., 2018), fewer men than women state support for FGC in almost all countries in which FGC is practised (UNICEF, 2013;Varol et al., 2015). Men have also been documented to express preferences for marriages or relationships women who have not been cut (Dellenborg, 2004), and male preferences regarding FGC have been shown to vary with men's socioeconomic profile rather than being uniform (Sakeah et al., 2006). Male preferences are discussed further Section 9.6.3 and 9.6.4.

Finally, the voice of academics and feminists from practising communities in Africa, has also challenged the idea that FGC is necessarily a symbol of oppression and patriarchy. Despite these challenges to the feminist theory of FGC, the view that FGC is explained by a patriarchal desire to control and subordinate women is commonly held and reflected in many statements made in development and policy literature (UN, 1995;WHO, 2014).

3.2.2 Modernisation Theory

Modernisation theory is a universal theory put forward to explain demographic and social change (Inglehart and Baker, 2000). The application of modernisation theory to FGC is closely linked to feminist explanations of FGC (Section 3.2.1), interpreting FGC as a means for women to gain social acceptance

and economic stability (Hayes, 1975;Yount, 2002;Boyle et al., 2002). However, modernisation theory focuses on women's economic opportunities, rather than their social status in relation to men, as the most important component of change (Althaus, 1997). Modernisation theory proposes that 'modernisation' will lead to reduced support for FGC, which is described as economic development through increased educational attainment, participation in the labour force, and increased urbanisation, as well as exposure to alternative ideas via the media and infrastructure. These factors are predicted to change women's position in society and alter women's reliance on marriage for their status and material well-being. This in turn, is anticipated to weaken the importance placed on FGC in society (Hayes, 1975;Yount and Balk, 2004;Van Rossem et al., 2016).

Evidence in support of this theory is mixed. A near universal finding is that women with more education are less likely to support FGC and have daughters with FGC (Boyle et al., 2002;UNICEF, 2013), and one study found that education became an alternative marital currency to FGC, due to the potential earnings that educated women were able to contribute to the family (Reason, 2004). However, the association between higher education and reduced FGC perpetration could be due to multiple factors other than modernisation (Hayford, 2005). Urban living has been shown to be associated with lower levels of FGC in some studies (Caldwell et al., 2000;Yount, 2002), whereas others have found no association (Carr, 2001). While economic development may lead to gradual erosion in FGC perpetration, modernisation theory does not appear to apply in all contexts (Shell-Duncan and Hernlund, 2000;Hayford, 2005).

3.2.3 Social convention theory of FGC

Social convention theory was first proposed to explain the persistence of infibulation specifically, although it has subsequently been applied to all forms of FGC (Mackie, 1996). Social convention theory was inspired by the disappearance of footbinding in China in one generation, a practice which is often equated to infibulation due to the restrictions it placed on women. Social convention theory was also inspired by ideas from coordination game theory (Schelling, 1978) (Section 2.3.4) and the evolutionary concept of paternity concern (Dickemann et al., 1981) (Section 2.3.2). Social convention theory suggests that men and women are trapped in a convention where both believe that FGC is essential for marriage. As the cost of testing these beliefs is prohibitive to any one individual, they theory predicts that behaviour will only change if the whole community agrees to abandon the practice simultaneously. It is proposed that in order for this to occur, a practising community must be educated about the harmful effects of FGC and exposed to an alternative convention in which FGC is not practised (Mackie, 1996). Social convention theory formalises observations made by others about the socially binding nature of FGC tradition (Obiora, 2007). Social convention theory also addresses the paradoxical role of women in enforcing FGC, which is explained by their inability to resist the practice rather than because of active

persistence (Longman and Bradley, 2015a). This is supported by observations that women comply with local practices because they do not want to risk their daughters' future stigmatization, rather than because they approve of the procedure, sometimes referred to as 'reluctant practitioners' (Gosselin, 2000a;Shell-Duncan and Herniund, 2006).

Collective abandonments were taking place in Senegal prior to the development of social convention theory, coordinated by a non-governmental organisation called Tostan. These appeared to provide empirical support for social convention theory (Mackie, 2000;Easton et al., 2003;Gillespie and Melching, 2010). Social convention theory was subsequently refined, with additional weight given to the importance of a critical mass of individuals leading the change to create a tipping point which others would follow, and the importance of social sanctions and rewards in maintaining social norms was also recognised (Mackie and LeJeune, 2009). Social convention theory is extremely influential and has been adopted by all international agencies in their FGC policies and programmes (UNICEF, 2005a;UNAIDS et al., 2008). Social convention theory provides a practical application for eradication programmes, which involves communities making abandonment pledges to not have their daughters undergo FGC, and not have their sons marry women with FGC. The idea of community-level rather than individual-level abandonment is particularly attractive to policy makers as it appears to have the potential to accelerate change (UNFPA and UNICEF, 2017). The efficacy of this eradication approach is discussed in Section 3.3.3.

However, despite the positive reaction from the international development community, several objections have been made to the social convention theory. Crucially, if FGC is a convention as predicted by social convention theory, then the prevalence in all practising communities should be close to 100%, however the observed FGC prevalences vary widely and there are many communities with less than 50% FGC prevalence (Easton et al., 2003;Efferson et al., 2015). Further, a study in Sudan found that cutting rates did not exhibit the patterns expected if families were coordinating their cutting practices at the community level among intramarrying groups, which refutes the concept that individuals are stuck in a coordination norm (Efferson et al., 2015), although this study was highly criticised by Mackie (Mackie, 2018). Another objection concerns the relevance of social convention theory to current contexts (Yount, 2002). The social convention theory proposes that infibulation originated under conditions of resource inequality and hypergyny, whereby women with FGC secured better marriages by signalling fidelity, and infibulation then became a prerequisite for all women (Mackie, 1996). However, resource inequality and hypergyny are not the case in many FGC settings, so the applicability of social convention theory to the persistence rather than origins of FGC is unclear (Sakeah et al., 2006;Shell-Duncan et al., 2011). A further concern is that social convention theory does not recognise the gender-based constraints on women's behaviour (Yount, 2002). Women and their families need to

acquire economic security through marriage whether or not they understand the benefits of alternative conventions.

An alternative interpretation of social convention theory suggests that social acceptance within peer groups is the basis for the convention rather than marriageability (Shell-Duncan et al., 2011). This proposes that girls with FGC are signalling respect and conformity to other women within the community. By doing this, girls and their mothers gain access to social networks, which translates into social security. In other words, female alliance formation, rather than marriage, is proposed to be driving the convention.

Numerous ethnographic accounts describe the considerable social stigma faced by women living in FGC practising communities who have not undergone FGC. Such women may be verbally insulted and labelled as unclean, ignorant, rude or immature and excluded from taking part in or attending specific activities, such as wedding ceremonies or funerals (Dellenborg, 2014;Shell-Duncan & Hernlund, 2004). In some situations, women have been reported to arrange to undergo FGC for themselves as adults in order to avoid these taunts, particularly uncut women marrying into a practising community (Hernlund, 2007). By contrast in the same communities women who have undergone FGC are described with respect and as figures of authority (Shell-Duncan et al., 2011). The attitude to FGC is also embedded in language. For example, in Sudan the word for a FGC (*tahoor*) translates as 'ritual cleaning' and is deeply imbued with connotations of cleanliness and purity. This contrasts with the word for uncircumised (*aghlaf* (m) or *ghalfa* (f)) which denotes dirtiness, and is used pejoratively. The absence of a respectful word to describe an uncut woman was tackled by an eradication programme which searched for a new positive term in collaboration with NGOs, artists and writers. The term Saleema was chosed which translates as undamaged, unharmed and complete, and may provide a step towards the possibility for change (El-Tom 1998; UNICEF, 2010).

3.2.4 Applying evolutionary anthropology to FGC

Evolutionary anthropology provides a different level of explanation to the social theories presented above (sections 3.2.1 - 3.2.3), by applying evolutionary theory to understand the ultimate, rather than proximate, causes of human behaviour (described in section 2.4.1). Unlike the proximate explanations for FGC behaviour which may vary by context, predictions about FGC behaviour based on evolutionary theory provide quantifiable predictions which are anticipated to apply in all contexts. Evolutionary theory predicts that humans will flexibly alter their behaviour in response to their context in order to optimise fitness (Tinbergen, 1963; Laland and Brown, 2011). Thus it is anticipated that FGC will be an adaptive response to the local context where it is practised, in terms of evolutionary fitness outcomes rather than impact on health and well-being (Hill, 1993). The potential controversy of discussing

evolutionary fitness benefits in relation to harmful cultural practices is discussed in Section 2.6. The proposal that FGC may enhance rather than reduce evolutionary fitness may seem counterintuitive given the health consequences that are associated with FGC. However, as discussed in Section 1.3.4 the results of studies examining the health consequences of FGC are mixed, and therefore the impact on fitness is also uncertain.

FGC is under parental control in many contexts. This is particularly the case where FGC takes place in infancy or childhood, although girls who undergo FGC during adolescence or at marriage may have more autonomy (Yoder and Wang, 2013). However, in general, parents make the decision for their daughters to undergo FGC, and as the primary actors, their fitness consequences must be considered (discussed in Section 2.3.1) (Hamilton, 1964). Either decision has the potential to limit their inclusive fitness; most obviously having FGC performed could limit fitness through their daughter's death in the most extreme circumstances, or otherwise through negative health consequence which may reduce their daughter's fertility. However, in contexts where FGC is required for marriage, a decision not to have FGC performed could also limit fitness if this affects their daughter's marriageability or reproductive success (Boyden et al., 2012). The balance of these fitness costs and benefits according to context are predicted to determine parental FGC behaviour.

In contrast to the attention that FGC has received from many other disciplines, there are relatively few studies that have addressed FGC using evolutionary theory. Only three empirical studies have tested the effect of FGC status on women's reproductive success, with mixed results. A study in Ghana, in a context in which FGC is a prerequisite for marriage, found that women with FGC were likely to marry and have their first child at a significantly younger age than women without FGC, and correspondingly achieved higher fertility (Reason, 2004). Similarly, a small study in Sudan found that total completed fertility was slightly higher for infibulated women compared to women with less severe forms of FGC (Gruenbaum, 2000). However, a larger study using Sudan DHS data found that infibulated women were twice as likely to have low fertility, defined as less than two children, than women who were not infibulated (Balk, 2000). The effect was interlinked with marital status, with infibulated women being both more likely to divorce, and to have lower fertility. The results of these three studies are therefore inconclusive, especially as two studies compared FGC type rather than presence or absence of FGC. The effect of FGC on fitness is therefore an open question.

Other evolutionary researchers have considered social influences on FGC behaviour. Two studies have examined social influences on FGC behaviour, both of which tested and found evidence of frequency-dependent social transmission of FGC behaviour, although the methods used raise concern over their findings. One study used Kenya DHS data to examine the influence of community pressures on cutting behaviour and found that women living in areas of higher FGC prevalence are more likely to have their

daughters cut (Hayford, 2005). However, DHS clusters rather than ethnic groups were used as the reference group for frequency-dependency, which represent a sampling area rather than a social community and often include individuals of varying ethnic groups. Further, only mothers with FGC were included in the study, so the effect of maternal FGC status on FGC prevalence was not captured. The other study which also tested for frequency-dependent FGC transmission was conducted in Colombia, however the behaviour in this study, termed 'female genital modification' does not involve injury and it is questionable whether this fits with the internationally accepted definition of FGC (Ross et al., 2015). Another study suggested that FGC might be interpreted using insights from costly signalling theory (Section 2.3.3) proposing that FGC signals sexual fidelity and paternity certainty, although does not test this empirically, and uses phylogenetic methods to try to uncover the origins of FGC behaviours (Ross et al., 2016). This is discussed further in Section 9.2.1.3.

3.3 FGC ERADICATION PROGRAMMES

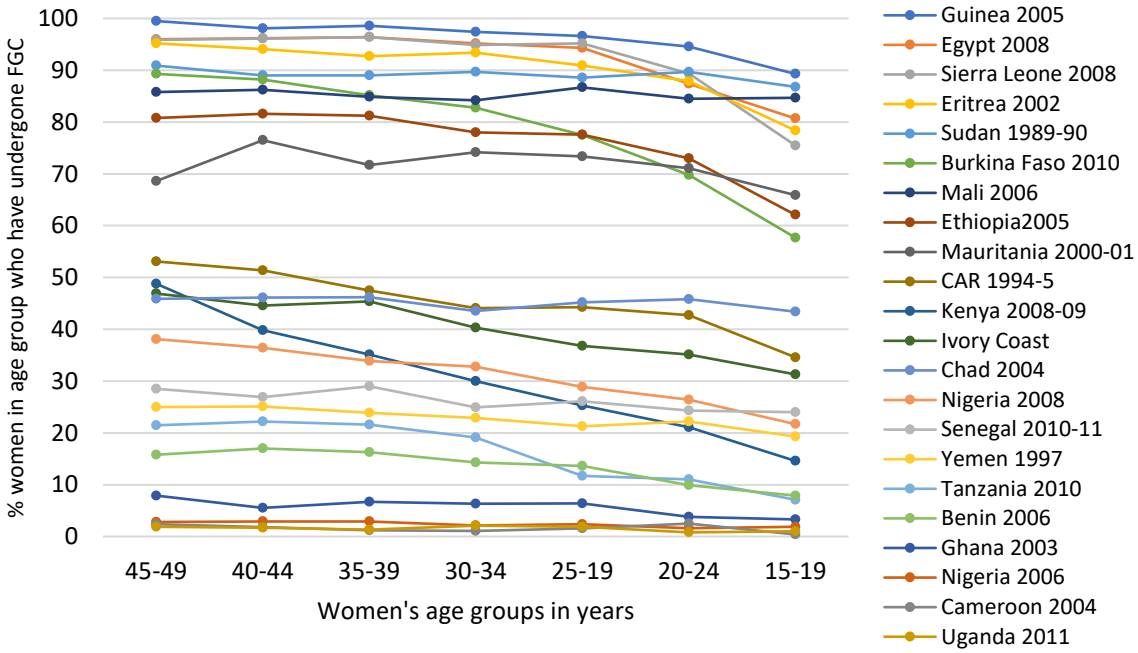
Translating the international eradication agenda described in Section 3.1.1 into effective local programme work has proved complex. Interventions have been met with resistance at a global and local level, and due to challenges concerning the monitoring and evaluation of FGC studies, the most effective strategy to bring about change is still unclear. The impact of legal change and direct programme interventions are discussed below.

3.3.1 Changes in FGC prevalence

Global FGC prevalence has declined over the 30 years since eradication efforts began in earnest, however, the pace of change has varied by country and overall the decline has been slower than hoped (WHO, 2011;UNICEF, 2013). Change in FGC prevalence is usually monitored by comparing FGC rates among 5-year age groups from a single survey (Yoder and Wang, 2013). Using the most recent DHS data, this method reveals that in all countries fewer girls in the youngest group have undergone FGC compared to the oldest group (illustrated in Figure 3.1). However, the rate of change is variable; in Sudan, Mali, Mauritania, Chad and Senegal the reduction has been less than 5%, whereas in Sierra Leone, Kenya and Burkina Faso the reduction has been over 20%.

An alternative approach to monitor change has used mothers' responses regarding the FGC status of their daughters and analysed the changes in prevalence among 0-14-year olds. This method showed much greater declines in prevalence e.g. from 71.4% to 8.0% in East Africa, and from 73.6% to 25.4% in West Africa (Kandala et al., 2018). However, this method has been challenged due to concerns about reporting bias, and that girls within these age groups may still undergo FGC. Using either method, it seems unlikely that the Sustainable Development Goal targeting FGC eradication by 2030 will be achieved (UN, 2016).

Figure 3.1 FGC prevalence among different age groups using most recent DHS survey data



Source: Measure DHS statcompiler

3.3.2 Impact of anti-FGC legislation

International standards advocate that the following activities should be criminalised; performance of FGC, procuring, arranging and/or assisting in acts of FGC, failing to report incidents of FGC, participation by medical professionals in acts of FGC, and cross-border FGC (28 Too Many, 2018). A recent review of FGC legislation in the 28 countries where FGC is most prevalent found that six countries have no anti-FGC legislation (Chad, Liberia, Mali, Sierra Leone, Somalia and Sudan), and that the legislation in the other 22 countries varies in scope, with penalties ranging 2 months to 20 years prison sentence, and fines ranging from $5.50 to $3,608 (28 Too Many, 2018).

The number of prosecutions related to FGC are extremely low compared to the estimated 3 million cases on FGC performed every year (Yoder et al., 2013;Muthumbi et al., 2015). The most recent UNFPA report revealed that in 2016 across all sub-Saharan African countries there were just 253 cases brought to court, 90 arrests, and 77 cases where convictions or sanctions were made (UNFPA and UNICEF, 2017). These figures indicate that legislation is not effective in criminalising the behaviour. The benefit of legislation is usually considered to be symbolic by providing an 'enabling environment' for anti-FGC campaigns, communities and individuals who support abandonment (Shell-Duncan et al., 2011).

Some commentators have concerns about FGC legislation which, by turning millions of women, girls and families into criminals overnight, may have unintended consequences and even hinder eradication efforts rather than reduce prevalence (Antonazzo, 2003). In Senegal and Kenya, it has been observed

that legislation has forced FGC underground, with the result that procedures are performed secretly, at a younger age and by inexperienced circumcisers, putting girls at greater risk (Shell-Duncan et al., 2011;Khamasi, 2015;Camilotti, 2016). Legislation may also deter women from seeking health care for themselves or their daughters when complications arise for fear of arrest, which could also put them at greater risk (Antonazzo, 2003).

3.3.3 Primary prevention of FGC

Over the past 30 years a variety of interventions have been undertaken to encourage individuals, families and communities to abandon FGC. Most programmes target and monitor secondary outcomes rather than FGC abandonment, for example intention to change, community pledges, raising awareness, or encouraging critical reflection of FGC (Askew, 2005;Johansen et al., 2013). It is unproven whether these changes necessarily lead to abandonment (Johansen et al., 2013). FGC interventions in all countries are a mix of programmes instigated by national governments, international donors, and grassroots non-governmental organisations.

Despite the declines in prevalence shown at the national level (illustrated in Figure 3.1) there are few success stories regarding specific interventions, partly due to the lack of good quality programme evaluations to demonstrate effectiveness (Diop and Askew, 2006). A recent WHO sponsored evaluation found that 71% of organisations implementing FGC programmes had not performed evaluations (WHO, 2011), and a recent systematic review found only eight interventions that had monitored the necessary information to allow evaluation (one of which examined cutting prevalence, and the others collected data on secondary outcomes such as changes in beliefs) only three of which were assessed to have been effective (Berg and Denison, 2012b). The most common programme interventions are discussed below.

Campaigns aimed at changing behaviour by educating women and families about the harm caused by FGC have been used since the 1980s. However, the success of this approach in unclear and it has been critiqued for several reasons. Firstly, the negative effects of FGC may be exaggerated as they often relate to the outcomes of infibulation, the most severe but also least common form of FGC (Toubia, 1995;Gosselin, 2000a). This leads to a 'credibility gap' between women's lived experiences of FGC and the purported health consequences (Shell-Duncan et al., 2011). Secondly, establishing the medical 'facts' is difficult given the range of procedures and the conflicting results from numerous studies (discussed in Section 1.3.4). In many practising communities, people are often already aware of the potential health risks but continue with FGC because of its perceived social and cultural importance (Obiora, 1997;Shell-Duncan and Hernlund, 2000;Gele et al., 2013). Finally, focusing on the health risks may result in families seeking a lower risk alternative, rather than abandoning FGC, for example this approach has been associated with traditional practitioners switching to 'safer' practices such as using a

fresh blade for each individual to avoid the risk of HIV, rather than abandoning the practice (Pemunta, 2012). The main benefits of a medical facts approach may be at a societal rather than individual level, for example influencing policy makers to promote laws or religious leaders to issue religious edicts against FGC, and by improving awareness and healthcare for women experiencing complications due to FGC (Brown et al., 2013). Education about health consequences may still be used to support other programmes but is rarely used as the sole intervention.

Alternative rites of passage have also been used, which involve adapting traditional coming-of-age ceremonies to exclude cutting. The intention is that girls can fulfil their cultural tradition but without undergoing FGC. This approach has been successful in Kenya and Uganda, however, it is only relevant to communities where FGC is part of a traditional rite of passage (Chege et al., 2001;Prazak, 2007). Commentators have observed that the success of this approach depends on how effectively it is adapted to the specific context and culture of the target community (WHO, 2011;Johansen et al., 2013).

Practitioners who perform FGC have also been targeted in an approach sometimes called 'handing over the knife' (Gosselin, 2000b). Programmes have both attempted to educate and deter practitioners, as well as seeking alternative professions or sources of income for traditional practitioners. However, these initiatives have not been successful primarily because the demand for FGC is not addressed, and even where practitioners are persuaded to stop performing FGC procedures, others have filled this gap (Gosselin, 2000b;Diop and Askew, 2006).

Community behaviour change initiatives are the current approach endorsed by multilateral agencies. This approach is heavily influenced by social convention theory and reflects the current interpretation that FGC is a communal, rather than an individual, behaviour (Mackie, 1996) (described in Section 3.2.3). The ultimate objective of most programmes is a public declaration of abandonment by the community (Diop, 2004;Monkman et al., 2007;UNICEF, 2008). Typically, a core group of individuals will lead the change through community group discussions, until a large enough group from an intramarrying community are ready to make a pledge to abandon FGC. Public ceremonies are thought to facilitate collective change, as individuals will only act when they believe that social expectations have changed (UNICEF, 2010;Johansen et al., 2013). This approach is believed to have high potential in rural African communities where collective decision-making is valued (UNICEF, 2010). Currently community behaviour change interventions are favoured by international donors and huge aid budgets are directed towards these programmes. For example, the UNFPA spent almost $21 million on such programmes in 2016 in sub-Saharan Africa during which time they reported that 3,277 communities made public declarations of abandonment, which they translate into 8.5 million individuals (UNFPA and UNICEF, 2017).

Although this approach has a strong theoretical basis and has been endorsed and adopted by all key international agencies (UNAIDS et al., 2008), the empirical evidence supporting the efficacy of community pledges is inconclusive, leading some to query this approach and use of funds (Efferson et al., 2015). It is unclear whether abandonment pledges translate into behaviour change and reduced cutting rates. To date successful programmes demonstrating a reduction in cutting rates following abandonment pledges have involved a small number of villages in very specific contexts, and success has not been demonstrated on a large scale (UNICEF, 2008;Diop and Askew, 2009). Success also varies between communities which queries whether this approach is necessarily a universal solution to FGC abandonment; the original Tostan programme in Senegal achieved a 30% reduction compared to the control village, whereas in Burkina Faso the reduction was just 3%, and in Somalia only the type of cutting was changed (Diop and Askew, 2006;Berg and Denison, 2012b). Consequently, this approach may not work in countries where FGC is a more pervasive social norm (Easton et al., 2003). Further, it is unclear whether behavioural change is sustained following intervention without ongoing support, and communities revisited after the intervention ended have been observed to revert to practising FGC (Diop et al., 2008).

3.4 CONCLUSION

International attempts to eradicate FGC has been met with resistance from many practising communities since interventions began. FGC is practised in Africa, Asia and the Middle East, yet those campaigning for its eradication have primarily come from the UK and USA. The anti-FGC conventions based on international human rights have been challenged by those defending their cultural rights. Anthropologists have been able to contribute to this debate by interpreting and understanding FGC practices from the perspective of practising communities (Shell-Duncan and Hernlund, 2000;Gruenbaum, 2001b;Sarkis, 2004). Cultural relativist ideas are important to our understanding of the persistence of FGC, as they also provide explanations for resistance to some eradication efforts (Gosselin, 2000a).

Although FGC rates are declining globally, translating the international instruments at the ground level has proved challenging and uncertainty remains about the most effective strategies to change behaviour. Despite the widespread, multimillion-dollar, long-standing eradication efforts undertaken to date, many populations have proved resilient to change and FGC remains at high frequencies. Eradication policies that are not accompanied by a multifaceted support programme are unlikely to succeed and have been shown to have unintended negative consequences as has been seen in other development initiatives (Gibson and Mace, 2006). Further understanding of the persistence of FGC is needed to inform behaviour change initiatives.

Three prominent theories have been put forward to explain proximate level causes of FGC perpetration. However, local variation of the practice may be best understood in its local context rather than looking for a transferrable theory that can explain the proximate causes in all contexts. By contrast, ultimate level explanations consider variation in ecological conditions to be fundamental to explaining human behaviour (Borgerhoff Mulder, 1991). Evolutionary anthropology provides a universally applicable framework which can be applied to harmful behaviours taking into account contextual variation. This approach has been demonstrated to be revealing when applied to other harmful behaviours, however, as yet evolutionary understanding of FGC persistence has been relatively unexplored e.g. (Lawson et al., 2015;Schaffnit et al., 2019b).

3.5 RESEARCH QUESTIONS

This review demonstrates that despite considerable research attention there is still much that is unknown about FGC behaviour. Few researchers have applied an evolutionary anthropology approach to understanding the persistence of FGC, and this gap in the literature presents an opportunity to both further understanding of FGC behaviour as well as further testing the extent to which evolutionary theory can be used to understand human behaviours (Cronk, 1991;Winterhalder and Smith, 2000;Nettle et al., 2013). The following research questions are addressed in this thesis.

What effect does FGC have on women's reproductive success and how does this vary by context?

Many researchers studying FGC are interested in trying to understand why FGC persists despite the detrimental impact it has on women and girl's health. Evolutionary anthropology is uniquely placed to address this question as ultimate explanations of behaviour are concerned with fitness consequences rather than the impact on health or well-being. In Chapter 6 an evolutionary approach is used to understand the ultimate drivers of FGC behaviour and to determine whether differing fitness consequences may explain the persistence of FGC.

How does FGC affect women's sexual activity before and during marriage?

Control of women's sexual behaviour is frequently put forward as an explanation for why FGC is performed. Feminist theory proposes that FGC and associated sexual control is a means to enforce gender imbalance and patriarchal values (Section 3.2.1), and evolutionary theory suggests that sexual control associated with FGC may benefit men by reducing non-paternity rates (Section 2.3.2). Evidence from the empirical literature is mixed, and this question is addressed in Chapter 5.

Is there evidence that men's paternity concern may be perpetuating FGC in populations?

Paternity concern is put forward as an explanation for FGC by evolutionary researchers (Section 2.3.2). This concept is supported by the more general ideas that FGC controls women's sexuality before and

after marriage within practising communities. Paternity concern has not been tested in the literature in relation to marriage choices, or in relation to FGC, this question is addressed in Chapter 5.

Does FGC affect women's marriage opportunities?

The relationship between FGC and marriageability is frequently referred to in theory, observational accounts and survey opinion data. However, few studies have tested this quantitatively. The association between women's marriage opportunities and their FGC status is addressed in Chapter 5.

CHAPTER 4 INTIMATE PARTNER VIOLENCE: GLOBAL CONTEXT, THEORY AND INTERVENTION

This chapter provides context to the research chapters on IPV that follow. Unlike FGC, the first studies into IPV were conducted by feminist activists and sociologists in the USA and UK in the 1970s, and anthropological and cross-cultural study followed. The initial concern of activists was to support victims of IPV as well as to raise awareness. The process of documenting the prevalence of IPV has been contributed to by social scientists and feminist and human rights activists, providing our current state of knowledge is discussed below. Theories which have been proposed to explain motivations for IPV perpetration are discussed, giving context to the evolutionary theory applied in Chapter 7. Primary prevention of IPV is a relatively recent development and an evaluation of the programme interventions which have been trialled to date is given. The chapter ends with the specific research questions concerning IPV which are addressed within the thesis.

4.1 GLOBAL UNDERSTANDING OF IPV

4.1.1 Contributions from the social sciences

In the late 1970s feminist scholars and psychologists began studying women's experiences of IPV in the UK and USA, interviewing women in shelters and producing case studies and qualitative research informed by feminist theory (discussed in section 4.2.4.) (Dobash and Dobash, 1979;Pagelow, 1980;Walker, 1980). Their work demonstrated that IPV was widespread and challenged the commonly held views at the time which considered violence by strangers to be more common than IPV (Thomas and Beasely, 1993).

Social scientists started studying IPV at the same time, with a different theoretical perspective which was referred to as conflict theory or 'family violence' theory (Straus et al., 1980) (see section 4.2.5). Social scientists introduced quantitative methods to study IPV, and developed the Conflict Tactics Scale in 1979 (revised in 1996 to include sexual violence) to use in surveys so that data on couples' behaviour, including violent acts, could be collected and measured systematically in a comparable manner (Heise, 2012). The Conflict Tactics Scale has been very influential in determining the way that IPV data is collected and is still widely used. However, it is criticised by feminist researchers concerned that this approach ignores the overlapping and repetitive nature of IPV, and does not capture violence perpetrated in self-defence (Kurz, 1989;Straus et al., 1980;Heise, 2012). Many influential social scientists do not consider IPV to be a gendered behaviour and are interested in male and female perpetrated violence. Many studies in this field have been concerned with studying and trying to establish the sex-symmetry of violence (Straus, 1999;Archer, 2000;Straus, 2014;Hamberger and Larsen, 2015).

4.1.2 Contributions from Anthropology

Anthropologists did not address IPV until the 1990s. Observations of so-called 'wife beating' or 'wife battering' were recorded by early ethnographers working in a range of countries during the early 20th century. However, these observations were usually part of a wider ethnography and, with a few exceptions, IPV was rarely the sole focus of study (e.g. Swartz, 1958;Pastron, 1974). This changed with the publication of two significant works. The first used the Human Relation Area Files to document the occurrence of violence cross-culturally, and the second was an anthology bringing together observations from a number of contexts (Levinson, 1989; Counts et al., 1992;). Both were important in demonstrating the cross-cultural variance in IPV, and differing influential factors on IPV. Levinson found that IPV prevalence was greater in communities in which men had more economic power, held the decision-making within the family, and which were characterised by conflict (Levinson, 1989), whereas the Counts' collection found that IPV was more common in settings without cultural sanctions against IPV and where wives were less able to leave their husbands temporarily or permanently (Counts et al., 1999;Counts et al., 1992).

These books inspired more anthropologists to study gender-based violence as a main subject of research (Wies and Haldane, 2011). Many anthropologists working in this field take an applied anthropological approach, engaging with the goal of reducing violence, and working with communities to understand how and why violence is perpetrated (Dauer, 2014). This has also included designing culturally appropriate interventions to change the traditional gender norms within communities (Lundgren and Adams, 2014).

Demonstrating the variability in violence is one of the important contributions that anthropology study has made to understanding IPV. This challenges perceptions that violence is an inevitable function of human nature and illustrates the importance of social context in determining violence (McClusky, 2001). Many anthropological studies have examined IPV using a framework in which structural explanations for violence rather than individual level explanations for IPV, are the focus. Structural factors include cultural beliefs and norms, as well as political and economic structures which may result in violence against women being tolerated. The relationship between individuals and these structures of power is thought to explain why IPV occurs (Dauer, 2014;Wies and Haldane, 2011).

Anthropological studies have also contributed an understanding of how violence affects women's everyday lives (Hearns, 2009), and made other contributions for example, examining how boys and girls

acquire definitions of masculinity which lead to tolerance or perpetration of violence against women (Lundgren and Adams, 2014).

4.1.3 Campaigns and international action

Unlike FGC campaigns which had an eradication agenda from the start, the first wave of IPV activism was aimed at supporting women who had experienced IPV, as well as raising awareness and campaigning for women's rights (Heise, 1996). Programmes aimed at primary prevention of IPV did not start until the 1990s (Jewkes, 2002;Smithey and Straus, 2004). During the 1970s and 1980s activists from local women's non-governmental organisations and grass roots organisations, primarily from the UK, USA and Latin America, lobbied to have IPV recognised as an international human rights and health issue (Heise, 2012). This lobbying resulted in the UN making a number of key resolutions, the most significant of which was the 1993 Declaration on the Elimination of Violence against Women, in which violence against women was recognised as a human rights violation for the first time (Thomas and Beasely, 1993;UN General Assembly, 1993). This was considered a symbolic event, and also compelled all states to address the structural and underlying causes of violence against women (Schechter, 1982;Heise et al., 1994;Heise, 2012).

Research into IPV gradually extended to other parts of the world (Connors, 1989). However, it was not until the 1990s, as women's human rights became an international concern, that systematic data collection was extended to non-Western nations. In 1994 the World Bank commissioned a report which pulled together all available data from the existing literature for the first time on the health consequences of experiencing IPV (Heise, 1993;Heise et al., 1994). In 1995 the WHO established their research methodologies for gathering data on violence against women and girls, and their first report on the global health impact of violence, including IPV, was published in 2002 (WHO, 1996;WHO, 2002). In 2010 a specific report on IPV was produced (WHO/LSHTM, 2010). Additionally, national surveys started to incorporate questions concerning women's exposure to violence. For example, the Demographic Health Surveys (DHS) developed a standard module on domestic violence which allowed comparisons between participating countries (WHO et al., 2013) e.g. (Kidman, 2017). The elimination of IPV is also specified in Goal 5 of the SDGs United Nation's Sustainable Development Goals (UN, 2016).

While the human rights approach to IPV eradication is not challenged from a cultural relativist perspective as with FGC, there was political and legal challenge querying the state's right to intervene in an individual's private life (Thomas and Beasely, 1993). In the 1970s when IPV campaigning started, domestic conflicts that took place within the home were considered beyond the scope of both government intervention and international human rights law (Finesmith, 1983). However, once the scale and severity of IPV was demonstrated, IPV became more clearly within the scope of state

responsibility, giving governments a mandate to intervene in the domestic sphere (Thomas and Beasely, 1993).

4.2 THEORETICAL FRAMEWORKS

Several theories have been put forward to explain IPV over the last 40 years, primarily from the disciplines of psychology, sociology and international development. The most prevalent theories are discussed below, which address three of Tinbergen's four levels (Tinbergen, 1963). Social learning theory provides an ontogenetic explanation for IPV perpetration (Section 4.2.1), the most commonly endorsed social theories provide proximate level explanations for IPV perpetration (Sections 4.2.2 - 4.2.7), and evolutionary theory provides an ultimate level explanations for IPV perpetration (Section 4.2.8).

Discussion regarding the motivations for different IPV types, in particular sexual or physical IPV, is absent from much of the theoretical literature. With the exception of ultimate level theories, the possibility that different IPV types may have different motivating factors is not widely acknowledged. The applicability of the proximate theories discussed below to sexual IPV is not addressed. Some theories appear more relevant to sexual IPV, such as feminist theory or social norms theory, whereas other theories such as family violence or resource theory are less obviously relevant to sexual IPV.

4.2.1 Social learning theory

Social learning theory suggests that individuals reproduce behaviours in adulthood that they see modelled in childhood (Bandura and Walters, 1977). This was first applied to IPV specifically in the 1980s and the concept of intergenerational transmission as an explanation for IPV has received varying support since then (O'Leary, 1988). A concern is that not all children who witness IPV perpetrate IPV as adults, and likewise, not all IPV perpetrators witnessed IPV in childhood (Widom, 1988). However, more recent studies indicate that adverse childhood experiences, whether witnessing IPV or experiencing abuse or neglect, are associated with IPV perpetration which has led to renewed interest in social learning theory e.g. (Dube et al., 2002;Fulu et al., 2013;Fonseka et al., 2015;VanderEnde et al., 2016;Yount et al., 2018). However, the cross-sectional data used in these studies makes it unclear whether witnessing violence in childhood is a marker of other factors (for example also experiencing violence in childhood) or if there is a causal social learning effect (Heise, 2012).

4.2.2 Biological and psychological explanations for IPV

Biological explanations (such as head injuries, varying levels of neurotransmitters or hormones, and genetic influences) and psychological explanations (such as a personality disorders, depression or psychopathology) have been proposed as possible explanations for IPV perpetration (summarised in (Ali

and Naylor, 2013a)). At an individual level some instances of IPV may be explained by these factors, and population-based studies have also found an association between depression or personality disorders in men and IPV perpetration, although the mechanisms and pathways are unclear (Fulu et al., 2013;Machisa and Shamu, 2018). However, biological or psychological explanations do not explain the varying levels of IPV found in different communities and countries, and ignore the importance of ecological and cultural influences on IPV occurrence (Ali and Naylor, 2013a).

4.2.3 Resource theory

Resource theory suggests that men will resort to violence when circumstances prevent them from fulfilling their socially proscribed role as provider, and when other resources (in the widest possible sense) are depleted or unavailable (Allen et al., 1975). Variations on resource theory include 'status inconsistency theory' and 'relative resource theory'. These stress that the relative resources of men and women within the partnership is more important than their proscribed social roles, and that women with more resources than their husbands may be at greater risk of IPV (Atkinson et al., 2005). This contrasts with predictions based on feminist theory (Section 4.2.4) which suggests that women with economic independence will be at less risk of IPV. Empirical evidence is mixed, and it appears that the balance of resources between men and women, and whether women's economic independence reduces IPV occurrence, is differently associated with IPV depending on the local context (Kim et al., 2009;Vyas and Watts, 2009;Ackerson and Subramanian, 2016;Caridad Bueno and Henderson, 2017;Lin-Chi, 2017). Relative resources alone seem unlikely to explain IPV perpetration, although may be a contributory factor.

4.2.4 Feminist theory of IPV

Feminist theory proposes that IPV is a gendered, sex specific behaviour that is a product of the patriarchal structure and gender imbalances in society (Dobash and Dobash, 1979;Pagelow, 1980;Bart and Moran, 1993). Accordingly, patriarchal values enforce women's subordinate status, and IPV and other forms of violence are used by men to exert control over women (Schechter, 1982;Kurz, 1989). Some feminists emphasise that IPV is not inherent to men, but is a result of the socially constructed norms of acceptable behaviour for men (Heise et al., 1994). However, although patriarchy describes the context in which IPV may be more likely to occur, it does not explain why men are violent towards their partners, and men's motivations for perpetrating IPV are unclear. Secondly, by positioning IPV as a sex-specific behaviour, feminist theory ignores the substantial evidence demonstrating the prevalence of female-to-male IPV perpetration, and also does not account for female-to-female IPV perpetration (Archer, 2000;Messinger, 2011). Researchers drawing on feminist theory today consider how gender imbalances and economic inequality may influence society, and thereby create social norms that condone IPV (Heise, 2011).

4.2.5 Family violence theory of IPV

Family violence is often positioned in contrast to feminist theory, particularly because it proposes that violence is used among family members to resolve conflict, rather than being used specifically by men towards their intimate partners (Gelles and Straus, 1979). Conflict might be triggered by factors such as anger, frustration or stress (Kurz, 1989). Research testing this theory is particularly concerned with establishing the sex-symmetry of violence to demonstrate that IPV is not a gendered behaviour. Some studies have found that female perpetrated IPV is equally prevalent as female directed IPV (Straus, 1999;Archer, 2000;Straus, 2014;Hamberger and Larsen, 2015). However, others argue that these findings primarily concern less severe forms of IPV, and are mainly from high income countries (HIC) (Archer, 2006;WHO/LSHTM, 2010). The bulk of studies have found that male perpetrated IPV is more prevalent, and that women are more likely than men to be injured by IPV (Whitaker et al., 2007;Straus, 2009;WHO, 2012c). Family violence theory is also criticised because it proposes general conflict as a motive for both male and female IPV perpetration whereas the evidence suggests that different factors drive men and women to perpetrate IPV in different contexts (Johnson and Ferraro, 2000;Hamberger and Larsen, 2015).

4.2.6 Social norms theory

Social norms theory is not one uniform theory, rather it is a general concept that has been arrived at by researchers from various disciplines who are interested in how social norms may perpetuate harmful practices (Heise and Manji, 2016). As such there is no set definition, but most agree that social norms describe how individual behaviour is influenced by beliefs about typical and appropriate behaviour within a social reference group (Mackie et al., 2015;Heise and Manji, 2016;Alexander-Scott et al., 2016). Social norms are thought to be maintained by approval or disapproval within the reference group resulting in a strong desire to conform. Importantly, as social expectations are based on beliefs about behaviour rather than actual behaviour, they can sometimes be incorrect (Alexander-Scott et al., 2016). This contrasts with frequency-dependent learning proposed by cultural evolutionary theorists which proposes that individuals adopt behaviours in relation to their frequency within their reference group (described in Section 2.4.2).

Examples of social norms relating to IPV include beliefs that men have a right to sex within marriage, or that violence is an acceptable way to resolve marital conflict (Alexander-Scott et al., 2016). Social norms around gender roles and the wider acceptability of violence, rather than specifically about the acceptability of IPV, may underpin IPV perpetration (Heise and Manji, 2016). Social norms theory may help to explain the varying levels of IPV found globally (Mackie et al., 2015).

In support of social norms theory studies using population-based data have shown that community factors or community-held beliefs are associated with the odds of individual men perpetrating IPV, for example the proportion of individuals who justify IPV, or the proportion of women with low levels of autonomy (Gage, 2005;Koenig et al., 2006;Boyle et al., 2009;Uthman et al., 2009;WHO/LSHTM, 2010). However, although social norms may affect the likelihood of any individual perpetrating IPV, this concept does not provide an explanation for all aspects of IPV. The theory does not explain why men rather than women are the most common perpetrators of violence (Jewkes et al., 2015), and it does not quantify the relative importance or explanatory power of social norms for a particular behaviour (Manji, 2018), and further, it does not explain why varying forms of VAWG and other forms of violence are found within the same community (Jewkes et al., 2015). Finally, as this is a relatively new area of theory, the definitions and terms are still unclear (Mackie et al., 2015).

4.2.7 Ecological Framework

Ecological models have been widely used in public health approaches over the past 20 years (McLeroy et al., 1988;Richard et al., 2011). This approach was applied to IPV perpetration in 1998 and unlike the single factor theories above, this ecological framework attempts to incorporate the wide range of factors that contribute towards individual IPV occurring (subsequently revised in 2012 (Heise, 1998;Heise, 2012). It proposes that factors at four levels contribute towards IPV perpetration; individual characteristics and experiences, factors concerning the intimate relationship, the community in which the couple live, and the wider macrosocial contexts. This conceptual model illustrates and incorporates the evidence that there is no single pathway to perpetration and recognises how different level factors can influence IPV occurrence. The ecological framework has been widely endorsed and was adopted by the WHO in 2002 as a basis for their IPV programme work (WHO, 2002). While useful for programme planning and as a conceptual model, this framework is limited in its explanatory power. As all proximate risk factors that have been identified for IPV perpetration are included within the framework, the relative importance of any individual element, or any level is unclear (Heise, 2011).

4.2.8 Applying evolutionary anthropology to IPV

An evolutionary anthropology approach, described in Chapter 2, provides an ultimate level explanation for human behaviour and is concerned with the fitness outcomes of behaviour. This provides a different level of explanation to the social theories presented above (sections 4.2.1 - 4.2.7). Unlike the proximate explanations which may vary by context, predictions about IPV perpetration based on evolutionary theory provide quantifiable predictions which are anticipated to apply in all contexts. Evolutionary theory predicts that humans will flexibly alter their behaviour in response to their context in order to optimise fitness (Tinbergen, 1963; Laland and Brown, 2011). Accordingly, applying this approach to IPV leads to a prediction that men will perpetrate IPV in contexts where the trade-off between the fitness

benefits associated with IPV outweigh the fitness costs (Laland and Brown, 2011). Fitness benefits resulting from male IPV perpetration could include reduced non-paternity rates by preventing their partner from having extra-pair sex (Buss and Duntley, 2011), increased reproductive success by using IPV as a form of 'reproductive coercion' within an intimate partnership (Miller et al., 2010), or increased reproductive success by using IPV to overcome a partner's objection to their own extra-pair sex (Stieglitz et al., 2011). The latter explanation is proposed as an explanation for physical IPV specifically, whereas paternity concern and 'reproductive coercion' hypotheses both predict physical and sexual IPV. These explanations are discussed in further detail and tested in Chapter 7. The potential controversy of discussing evolutionary fitness benefits in relation to harmful behaviours is discussed in Section 2.6.

However, IPV perpetration may also be associated with evolutionary fitness costs. As long-term pair bonding is a human universal and apparently successful strategy, the costs of jeopardising the bond through IPV are anticipated to be substantial, and the possibility that IPV serves no adaptive purpose must be considered (Marlowe, 2000). Perpetrators risk retaliation from their wife or their wife's kin, either physically, or via exclusion from social networks which could impact on resources and opportunities (Jones and Ferguson, 2009;Clark et al., 2010). The wife's fertility, and therefore the husband's reproductive success, may be negatively affected by the health consequences associated with IPV experience (discussed in Section 1.4.4.) which include pregnancy loss, prematurity and infants of low birth weight (Valladares et al., 2002;Coker, 2007;Hill et al., 2016). IPV has also been demonstrated to have a detrimental impact on the health and well-being of children (described in Section 1.4.4) which could reduce the perpetrator's fitness. Perpetrators also risk their wife's defection from the relationship which also has costs associated with finding an alternative 'mating partner' and not being able to protect and invest in their children (Marlowe, 2000).

Only one research group has applied an evolutionary anthropology approach to understand IPV perpetration, using data collected from an Amazonian forager-horticulturalist group (Stieglitz et al., 2011;Stieglitz et al., 2012). This study tested for an association between IPV and male reproductive success, finding that IPV perpetration predicts higher marital fertility for men (Stieglitz et al., 2018).

The majority of studies which have applied evolutionary theory to IPV have been conducted by evolutionary psychologists who are interested in the universal cognitive function of male sexual jealousy and coercion which is proposed as an evolved adaptation to address the issue of female infidelity and paternity uncertainty (described in Section 2.3.2) (Daly et al., 1982;Goetz and Shackelford, 2006;Goetz et al., 2008;Buss and Duntley, 2011). These studies are primarily conducted in HIC contexts, often in experimental conditions, and do not control for contextual factors or perpetrator profile within the analysis (Laland and Brown, 2011). As such, they do not offer an explanation for the fitness consequences of context-specific IPV perpetration.

To my knowledge no researchers have applied cultural evolutionary theory to IPV perpetration. However, numerous studies have tested how social norms may influence IPV perpetration using conceptual ideas akin to the cultural evolutionary theory of frequency-dependent transmission or conformity bias (Efferson et al., 2008;Alexander-Scott et al., 2016;Heise and Manji, 2016). One pertinent study demonstrated that the risk of IPV was substantially higher for women living in communities where proportion of other women reporting beatings exceeded the sample mean (McQuestion, 2003).

Addressing IPV from a different theoretical perspective, another study has applied cooperation game theory (discussed in Section 2.3.4) to understanding IPV perpetration using DHS data from Colombia. This study focussed on the power dynamics between husband and wife and how the dynamics of this relationship and alternative sources of bargaining power available to women, such as education may reduce the risk of IPV occurring (Jones and Ferguson, 2009).

4.3 IPV CHANGE PROGRAMMES

Until recently the majority of human and financial resources were directed towards providing support for women who had experienced IPV in both HIC and low- and middle-income countries (LMIC), rather than preventing IPV perpetration (WHO/LSHTM, 2010). Primary prevention programmes are at a very early stage and an evidence base for effective programmes and policies is yet to be established (WHO/LSHTM, 2010). The impact of legal change and direction programme interventions are discussed below.

4.3.1 Changes in IPV prevalence

As primary prevention programmes have only recently been implemented in all contexts, significant change in prevalence resulting from programme work is not yet anticipated. For LMIC historical data is not available for comparison, and unlike FGC, rates of change for IPV cannot be measured using women's age groups (Section 3.3.1.) as women remain susceptible to IPV throughout their lives. In the USA a 64% decline in IPV was reported between 1993-2010, representing a reduction of 9.8 to 3.6 victimisations per 1,000 women (Catalano, 2012). Some experts attribute this dramatic decline to the Violence against Women Act authorised by the US Congress in 1994 which also allocated significant funds to numerous interventions, in particular programmes targeting child maltreatment (Smithey and Straus, 2004;Ellsberg et al., 2015). However, others attribute the decline to women's improved economic status or to changes in demography resulting in an aging population, rather than to IPV programme interventions (Farmer and Tiefenthaler, 2003). The same change has not been seen in other high-income countries (Kangaspunta and Marshall, 2012).

4.3.2 Impact of anti-IPV legislation

The 1993 Declaration on the Elimination of Violence against Women entreats all parties to end violence against women. IPV legislation has been passed in many countries however, there remain a number of countries where IPV is not legislated against. Of the 189 countries monitored by the World Bank, 155 countries currently have some form of legislation against marital rape, and 144 have some form of legislation against IPV, with varying terms as to whether sexual, physical, emotional or economic violence are covered by the legislation, and with varying severity of penalties and protection orders (World Bank Group, 2018). The UN estimates that more than 600 million women live in countries where domestic violence is not considered a crime (Turquet, 2011).

Measures to criminalise IPV are deemed important in creating a climate of non-tolerance, and shifting attitudes by making IPV a matter of public concern (Heise and Garcia-Moreno, 2002;Jewkes, 2002). However, as with FGC, legal instruments are often considered to be symbolic, rather than a true deterrent of IPV and enforcement is challenging due to the private nature of IPV (Kurz, 1989;Smithey and Straus, 2004;Ellsberg et al., 2015). Legal and policy reforms have little effect without accompanying measures to effect behavioural change (Thomas and Beasely, 1993;Heise and Garcia-Moreno, 2002).

4.3.3 Primary prevention of IPV

A number of different intervention programmes that are being trialled in various settings are outlined below. However, programme evaluations performed to date have suffered from small sample sizes, a range of incomparable outcome measures and timeframes, confounding factors not being controlled for, and lack of long-term follow up make it unclear whether any changes were sustained over time (Ellsberg et al., 2015). A review performed in 2010 found only one strategy that had sufficient programme evidence to support its effectiveness; school-based programmes to prevent dating violence, discussed below (WHO/LSHTM, 2010).

Adverse childhood experiences such as neglect, maltreatment and physical and sexual abuse have been identified as risk factors for individuals becoming a victim or perpetrator of IPV in adulthood (Foshee et al., 2009;Fonseka et al., 2015). IPV prevention programmes have started to target child maltreatment, with the objective of both reducing incidence of adverse childhood experiences and as well as reducing IPV occurrence in later life. This is a long-term strategy and few programmes have reached a stage where programmes can be evaluated (WHO/LSHTM, 2010). In HIC contexts strategies which include home visitation and parent education programmes have demonstrated some success, but trials in LMIC are yet to be evaluated (Mikton and Butchart, 2009).

Programmes aimed at increasing women's financial empowerment have been implemented in a number of settings. Feminist theory predicts that increasing women's access to financial resources will reduce their risk of experiencing IPV (discussed in Section 4.2.4). Women's financial autonomy could reduce violence by enabling women to leave a violent relationship, or provide women with greater value and autonomy within the household, as well as reducing household economic stress which has been shown to be a trigger for conflict (Heise, 2011;Ellsberg et al., 2015). However, relative resource theory predicts that women who have higher resources than their husband may be at greater risk of IPV (discussed in Section 4.2.3). The conflict between these two theoretical stances appears to be born out from the mixed results of interventions aimed at increasing women's financial autonomy. Unconditional cash transfers given to women have been shown to have an effect on reducing IPV in Kenya (Haushofer et al, 2013) and Ecuador (Hidribo et al, 2013). Microfinance programmes have been shown to reduce IPV in South Africa but only when combined with a gender equity programme (Kim et al., 2009). However other studies have found that economic empowerment programmes increase IPV incidence (Schuler et al., 1996;Kabeer, 2001;Ahmed, 2005).

A range of interventions targeting men and boys have been trialled in HIC and LMIC settings. Typically, these interventions are not directed at known perpetrators, rather their aim is to change norms and prevent IPV incidence rather than reduce perpetration. The most successful approach in HIC settings are programmes in schools that aim to reduce dating violence. One study found that the incidence of dating violence of all types was reduced at all four follow up periods up to four years post-intervention, a further 12 evaluations all show similar results (Foshee et al., 2005), and other studies have had similar findings (Wolfe et al 2013, Wolfe et al 2009). As dating violence increases the risk of IPV perpetration in later life, changing young men's behaviour and preventing dating violence may have long term preventative impacts on IPV, however similar approaches have not been trialled in LMIC (Heise, 2011).

There is increasing evidence that social norms relating to the acceptance of IPV and male authority affect the likelihood of men perpetrating IPV (discussed in Section 4.2.6). Consequently, social norms change programmes are a new area of intervention, which seek to rectify misperceptions about behavioural norms within the group and generate new norms with mixed success (Alexander-Scott et al., 2016). An approach developed by an African non-governmental organisation called SASA! and implemented in 40 LMIC, which runs training sessions with groups of men and women aiming to change attitudes, has been demonstrated to reduce community IPV prevalence in Uganda and South Africa (Abramsky et al, 2014). However other programmes in South Africa which involved group training with men and women (run by Stepping Stones and Sisters For Life) showed that men reported reduced rates of IPV following the programme whereas women did not report reduced rates of IPV experience, querying the validity of the outcome (Heise, 2011;Ellsberg et al., 2015).

4.4 CONCLUSION

Current awareness of the widespread prevalence of the different forms of IPV is a result of a long process of activism that began in the 1970s in HIC settings. The feminist provenance of the study of IPV, coupled with the ongoing question regarding the sex-symmetry of IPV perpetration, have been influential in shaping the research questions which have been studied and the knowledge contributed to the literature (Heise, 1996). Large scale studies collecting data from LMIC only began in earnest around 20 years ago, and there are still many unanswered questions concerning the motivations and risk factors for IPV perpetration in all contexts (WHO, 2002;García-Moreno et al., 2005;Ellsberg et al., 2008;Abramsky et al., 2011).

Intense activism resulted in violence against women and girls being addressed by the United Nations' Declaration on the Elimination of Violence against Women (Thomas and Beasely, 1993;UN General Assembly, 1993), and elimination of all forms of violence against women and girls is targeted by the United Nation's SDGs (UN, 2016). However, translating this international agenda into domestic policy has proved challenging. Legislation is now in place in many, but not all, countries (World Bank Group, 2018), but primary prevention programmes have only been implemented in LMIC in the past decade. The scarcity of interventions coupled with a paucity of good quality programme monitoring and evaluation means that an evidence base for effective prevention strategies has not been established (WHO/LSHTM, 2010). Achievement of the UN's SDGs targeting eradication of violence against women and girls by 2030 looks unlikely (UN, 2016).

Although IPV is found worldwide, the varying prevalence in different communities suggests that cultural, ecological and social factors influence its expression. Theoretical models that do not address cultural diversity in IPV occurrence will not provide a full explanation. Many of the single factor theories discussed above have now been superseded by, or incorporated into, the ecological framework which recognises the interplay of multiple factors that contribute towards IPV occurrence (Heise, 1998). However, although the ecological framework acknowledges the influence of community and national context as well as the varying risk factors, it does not address motivation.

Evolutionary explanations for IPV are not alternatives to the ecological framework or other proximate theories, rather they consider a different level of motivation for IPV (Tinbergen, 1963). In fact, there is substantial overlap between ultimate and proximate determinates of behaviour concerning the importance of context in determining behaviour, as well as the common risk factors that are associated with an increased likelihood of IPV perpetration. However, an evolutionary approach goes beyond identifying risk factors, and provides a framework for understanding why these risk factors increase the risk of IPV (Figueredo et al., 2012).

4.5 RESEARCH QUESTIONS

This chapter demonstrates that IPV perpetration remains a poorly understood behaviour with significant public health impacts. The prevalence and persistence of IPV remains a pressing concern for policy makers, and an evolutionary approach has the potential to contribute further to the knowledge base used for planning effective interventions. The following research questions are addressed in this thesis;

Are evolutionary motivations, such as paternity concern or sexual conflict, associated with IPV perpetration?

Evolutionary theory predicts that men will perpetrate IPV in contexts where the fitness benefits associated with IPV outweigh the fitness costs. The fitness consequences associated with male behaviours are difficult to determine without DNA testing due to issues of paternity certainty. In this research proxy indicators that are indicative of evolutionary concerns, based on a sexual conflict framework, are used to examine whether IPV may be motivated by evolutionary factors.

Are motivations for physical and sexual IPV are the same?

Physical and sexual IPV are often grouped together as a single measure in studies examining risk factors for IPV perpetration. However, the profile and consequences of these behaviours are quite distinct. In Chapter 7 the risk factors associated with either behaviour are tested separately.

Is there an association between IPV experience and FGC status?

It is frequently asserted that FGC and IPV have the same root causes, namely patriarchal norms and gender inequality, and a recent UN policy note encourages strengthening policy linkages between FGC and IPV programme work (UN Women, 2017a;UN Women, 2017b). However, the association between these two behaviours has not been established and IPV and FGC perpetration appear to be quite distinct behaviours. Their association is tested in Chapter 8.

CHAPTER 5 IS THERE A LINK BETWEEN PATERNITY CONCERN AND FEMALE GENITAL CUTTING IN WEST AFRICA?[1]

Abstract

Here we explore the relationship between female genital cutting (FGC), sexual behaviour, and marriage opportunities in five West African countries. Using large demographic datasets (n 72,438 women, 12,704 men, 10,695 couples) we explore key (but untested) assumptions of an evolutionary proposal that FGC persists because it provides evolutionary fitness benefits for men by reducing non-paternity rates. We identify and test three assumptions implicit in this proposal. We test whether cut women have reduced extra-pair sex before or within marriage; whether FGC is associated with a younger age at marriage as an indication of partner preference; and whether individual and group-level indicators of paternity concern are associated with a stronger preference for marriage to women with FGC.

Our results show that FGC status does not affect the odds of women engaging in several indicators of premarital sex, however women with FGC have significantly lower odds of having more than one lifetime sexual partner. We also show that women with FGC get married at a younger age which supports the argument that FGC status influences women's marriage opportunities, even when it does not restrict sexual activity. Finally, we find that in population groups where reported sexual activity and perceived risk of women's extra-pair sex is high, men have higher odds of marrying a first wife with FGC. Together, these results indicate that paternity certainty may be one of several factors contributing to the persistence of FGC in this sample, and that group-level sexual norms are key to maintaining the practice of FGC through the marriage market.

5.1 INTRODUCTION

5.1.1 The paternity certainty theory of female genital cutting (FGC)

Paternity uncertainty is an evolutionary problem for men who risk investing in offspring they are not genetically related to and reducing their own evolutionary fitness, if their partner engages in extra-pair sexual activity. This is particularly true for men with high paternal investment (Trivers, 1972). To reduce this risk, it has been argued that men use a range of so called 'anti-cuckoldry' tactics to prevent their long-term partner from conceiving with another man (Geary, 2005). At the individual level these may include partner preferences, 'mate guarding' (preventing loss of partner to competitors), and sexual

[1] This chapter was co-authored with Mhairi A. Gibson. Here the paper appears with minor amendments to the published version, and with heading numberings adjusted for thesis format. Howard, J.A. and Gibson, M.A., 2019. Is there a link between paternity concern and female genital cutting in West Africa? Evolution and Human Behavior, 40(1), pp.1-11.

jealousy behaviours (Buss, 1989;Goetz and Shackelford, 2006). At the population level, some cultural practices have also been described as mechanisms to control female sexuality and increase paternity certainty. Examples include virginity testing, foot binding, female claustration, marriage to prepubertal girls, and religious dogmas restricting female behaviours (Dickemann, 1981;Strassmann et al., 2012). Female genital cutting (FGC) is also described as such a mechanism.

The idea that FGC impedes women's sexuality is consistent with some local views of FGC (Adongo et al., 1998;Skaine, 2005), however Hartung was the first evolutionary scientist to suggest that FGC might provide a fitness benefit for men by reducing their wives' desire for extramarital sex, and thus enhancing men's paternity certainty (Hartung et al., 1976). Paternity concern is proposed as one of the key drivers behind the persistence of the practice leading to a preference for marriage to women with FGC, which in turn encourages families to have FGC performed on their daughters to enhance their marriageability (Van Rossem and Gage, 2009;Onyishi et al., 2016). Unlike individual anti-cuckoldry behaviours, it is proposed that FGC (and other similar harmful cultural practices which restrict women) may be enforced indirectly by men's marriage preferences (Boyden et al., 2012;Mackie, 1996;Shell-Duncan et al., 2011;Gruenbaum, 2005). Paternity certainty is not the only theory which has been put forward to explain the persistence of FGC. Other explanations refer to its function as a marker of group identity (Wilson, 2008), female alliance formation (Shell-Duncan et al., 2011), and conformity to social norms (Mackie, 1996;Hayford, 2005). Multiple factors almost certainly contribute to the persistence of FGC, however, it has become widely accepted by both social scientists and policy-makers that FGC also controls women's sexuality for the benefit of men (Dorkenoo, 1994;UN, 1995;Mackie and LeJeune, 2009;WHO, 2014;Toubia and Sharief, 2003).

As women's genitals are cut it seems likely that sexual control may have been a motivating factor for the origin of FGC. However, the suggestion that paternity concern can explain the persistence of FGC in present day communities involves a number of unproven assumptions which require scrutiny. Firstly, this proposal assumes that FGC reduces women's extra-pair sex. Here extra-pair sex is defined as sexual intercourse with someone other than a woman's husband or long-term partner, which can take place either before or during marriage. Secondly, it assumes that there is a preference for men to marry women with FGC. And thirdly, it implies that evolutionary forces are driving men (and their families) with the greatest uncertainty over paternity to show a stronger preference for marriage to women with FGC. Elements of this sequence have been tested in the existing literature (described in Section 5.1.2), but to our knowledge this relationship has not been addressed as a whole.

5.1.2 Prior literature

Here we only review studies relevant to FGC and paternity certainty. There is a large body of literature beyond the scope of this study which explores alternative or complementary non-evolutionary explanations for FGC (Shell-Duncan et al., 2011;Shell-Duncan and Hernlund, 2000;Ross et al., 2016;Dorkenoo, 1994).

Reduced sexual desire is the crux of the paternity certainty theory of FGC. The comparative sexual functioning of women with FGC has been the subject of numerous studies using a variety of indicators (arousal, pain and/or orgasm during intercourse, sexual desire and frequency of intercourse) to assess the impact of FGC. A systematic review of 16 studies published between 1997 and 2005 found no effect of FGC reducing women's sexual function or enjoyment of sexual relations (Obermeyer, 2005). However, a subsequent systematic review of 15 further studies found that women with FGC were significantly more likely to report painful sexual intercourse, no sexual desire and less sexual satisfaction (Berg and Denison, 2012a). Additional studies have found support for FGC attenuating sexual feelings (Anis et al., 2012;Oyefara, 2015;Onyishi et al., 2016) while others have not (Nyairo, 2013). Qualitative ethnographic studies also present contrasting accounts, with some documenting sexual enjoyment by women with FGC (Lightfoot-Klein, 1989;Ahmadu, 2007;Esho et al., 2010) while others describe painful sexual experiences (El Dareer, 1982;Dorkenoo, 1994;Dopico, 2007). These mixed findings may reflect varying FGC severity and the methodological difficulties involved in such studies, but they also imply that FGC does not necessarily reduce women's sexual function or desire.

Sexual desire, however, is not a prerequisite for sexual intercourse and women may engage in extra-pair sex for other reasons, including being coerced. Several studies have analysed women's sexual activity in relation to their FGC status, often in relation to women's sexual health or HIV/AIDS rather than from an evolutionary perspective. These show no significant difference in; the incidence of premarital sex; the total number of lifetime sexual partners; or the age at first sex (Odimegwu and Okemgbo, 2000;Okonofua et al., 2002;Msuya et al., 2002;Klouman et al., 2005b;Van Rossem and Gage, 2009;Smolak, 2014;Mpofu et al., 2016). The results of the few studies examining extra-pair sex during marriage are mixed. One found a higher proportion of women with FGC reported extra-pair sex (Oyefara, 2014b), another found no significant difference (Yount and Abraham, 2007), and another found that women with FGC had a significantly lower incidence of extra-pair sex although the sample size was small (Onyishi et al., 2016). In summary, the majority of these studies find that FGC status is not a clear predictor of reducing women's sexual activity.

Men's stated preferences in relation to their wife's FGC status have only been addressed to a limited extent in the literature. Qualitative studies have found that women's FGC status can have an impact on

marriage preferences for men, although the reasons given and direction of preference vary (Adongo et al., 1998;Missailidis and Gebre-Medhin, 2000;Abathun et al., 2016). Quantitative studies analysing men's stated preferences using small sample sizes have also found contrasting results depending on the man's age, education and nationality, making it clear that context is important in determining preference (Almroth et al., 2001a;Sakeah et al., 2006;Gele et al., 2013). An alternative approach to understanding marriage preferences is to consider age at first marriage in relation to FGC status. Earlier age at marriage can be used as an indicator of preference, which is supported by the fact that male fitness is enhanced by marrying a younger wife (Bereczkei and Csanaky, 1996;Fieder and Huber, 2007). Two West African studies (in Guinea and Nigeria) found no significant difference in age at first marriage by FGC status (Okonofua et al., 2002;Van Rossem and Gage, 2009), while a further study (in Ghana) did find that women with FGC marry earlier than women without FGC (Reason, 2004). Therefore, the question of whether FGC improves marriageability for women is still open.

Although a range of male behaviours (e.g. mate guarding, sexual jealousy) motivated by paternity concern have been documented (Daly et al., 1982), individual variation in paternity concern is not well understood. Studies have typically examined sex-specific displays of such behaviours to demonstrate the concept of paternity concern, rather than identifying why some individual men have higher paternity concern prior to marriage or conception. To our knowledge no studies have tested men's individual variation in paternity concern through marriage rather than mating preferences. Further, no studies have tested the link between a man's level of paternity concern and the FGC status of his wife. Possible reasons for men having higher paternity concern preceding marriage could include either their perceived risk of their partner engaging in extra-pair sex and/or their anticipated paternal investment. The theory of parental investment predicts that paternal investment and paternity certainty are correlated (Trivers, 1972) and it follows that men who expect to invest less (time, resources, and status) in their offspring should have less concern about paternity (Alvergne and Lummaa, 2014). For example, less paternity concern is anticipated in matrilineal groups where males invest in their sister's offspring (not their own) (Hartung, 1985;Holden et al., 2003).

Studies examining male mate preferences have typically tested preferences for phenotypic variation of potential female partners, such as waist-hip ratio or facial symmetry as an indicator of fecundity or good genes (Thornhill and Gangestad, 1999;Sorokowski et al., 2014). Only a few have considered male preference for female attributes which could be associated with paternity concern. Preference for certain female facial features have been suggested to be motivated by paternity concern, for example neutral or recessive features which would allow the man's dominant or 'sender' features to be expressed in offspring thus providing evidence of paternity (Salter, 1996;Bovet et al., 2012). In other studies men have shown preference for characteristics such as faithfulness and chastity, and a dislike of

promiscuity and sexual experience, in selecting their long-term partner (Buss, 1989;Buss and Schmitt, 1993). These studies investigate mate preference, however marriage preference (which has different motivating factors and does not necessarily align with mate preference) is more relevant to our research question. As far as we know, no studies have addressed marriage preference in relation to paternity concern.

5.1.3 Our approach and predictions

Here we identify and explore three assumptions underlying the paternity certainty theory of FGC and test the extent to which these assumptions may be driving the persistence of FGC in current populations. We used datasets from five countries in West Africa collected by the Demographic Health Survey programme (DHS) (see Section 5.2.1 below). We anticipate behaviour will vary according to individual circumstances, and a cross-cultural approach allows us to explore contextual variation at national and ethnic group levels.

We test three hypotheses;

1) Women with FGC are less likely to have extra-pair sex. Women with FGC are predicted to have lower incidence of several different indicators (see Table 5.1) of extra-pair sex compared to women without FGC.

2) Women with FGC marry earlier than women without FGC. Younger age at marriage for women is used as a proxy for marriage preference.

3) Men with high paternity concern are more likely to marry a first wife with FGC. Here we examine the relationship between the FGC status of a man's first wife and several different individual and contextual proxies for paternity concern; a) individual sexual experience and indicators of paternity concern; b) the prevalence of extra-pair sexual activity within a man's community; and c) expected levels of paternal investment within the man's community (matrilineal versus patrilineal groups).

5.2 METHODS

5.2.1 Data and study site

The Demographic Health Surveys Program (DHS) conducts surveys using nationally representative population samples, collecting data on a wide range of variables concerning health, fertility, and reproduction (www.dhsprogram.com) (ICF International, 2012). Women and men surveyed by the DHS are 15-49 and 15-59 years old respectively. The data is intended for policy formation, programme planning, monitoring and evaluation by the host country, and is also widely used by the UN and WHO. The datasets are publicly available, and the large sample sizes and wealth of variables collected in a

comparable format across many countries also make it an excellent source of information for examining our hypotheses (Corsi et al., 2012). Relevant data is collected on female genital cutting, sexual experiences, marriage and socioeconomic profile. We have addressed the limitations of the data for our research purposes (reporting bias and survey relevance to research question) where possible, as explained in Sections 5.2.2 - 5.2.4.

For this study, countries from West Africa were selected based on the range of FGC prevalence in the ethnic groups within them (1-99%) which allowed us to explore the contextual effect of FGC prevalence on behaviour; Ivory Coast 2011-12, Mali 2006, Nigeria 2008, Burkina Faso 2010 and Senegal 2013. Together these datasets provided data on 72,438 women, 12,704 men, and 10,695 couples where FGC status was known, from 47 ethnic groups.

In the selected countries FGC typically takes place in infancy (75.6% of women in this sample were cut by age five) and is therefore under parental control. The DHS surveys ask women if they have been circumcised (translated into the local term as appropriate) and those who respond affirmatively are asked what procedure was performed; 'skin nicked', 'flesh removed' or 'sewn closed'. The most common FGC type in the five study countries is 'flesh removed' (69.1% of women with FGC) (Appendix Table 5.1). Where FGC type is used in our statistical analysis, women are classified by the most severe procedure that they responded affirmatively to, excluding those who did not respond to the procedure-type question.

The DHS treats cohabitation and marriage equivalently. Respondents are asked if they are currently married or living with a partner as if married, and the date of first cohabitation is coded as the date of marriage. This reflects marriage practices in West Africa, where marriage is not necessarily a discrete event and the order of events may vary; a union may be preceded by cohabitation and/or consummation, and the union may be unofficial until bridewealth is received by the bride's family (Meekers, 1992). Most marriages are between individuals from the same ethnic group; Mali 75%, Senegal 83%, Burkina Faso 92%, Nigeria 94% and Ivory Coast 96%.

Multilevel models were used for all statistical analysis, pooling data from the five study countries. Multilevel models deal with hierarchically structured data and partition the sources of behavioural variance at different levels within the model. This approach is particularly appropriate for DHS datasets as ethnic group affinity has been shown to be a strong determinant of individual behaviour (Yoder and Wang, 2013), and the multilevel model structure allows for this clustering at the ethnic group level. Three levels were used here; individuals (n varies depending on the model), nested within ethnic groups (n 47), nested within countries (n 5). All women from an identified ethnic group were included in the analysis, excluding women in grouped or 'other' ethnic group categories.

5.2.2 Methods Hypothesis 1: Women with FGC are less likely to have extra-pair sex

To test whether FGC status affects incidence of women's extra-pair sexual activity, we calculated a number of different indicators of extra-pair sex from variables collected by the DHS surveys; age at first sex, age at first marriage, age at first birth, total lifetime number of sexual partners and the number of sexual partners excluding their spouse in the preceding 12 months. Responses for sensitive subjects such as sexual experiences may be subject to reporting bias. While there is no reason to believe that this would vary across ethnic groups or countries, it could influence our results. We attempted to allow for reporting bias in two ways; firstly, we only included data for women who were surveyed alone. The DHS records the presence of others during the survey interviews and our analysis (not included here) showed significantly less sexual activity was reported by women when others were present. Excluding these women (n6,280) gave a sample of n65,618 women with known FGC status. Secondly, we calculated six different indicators of extra-pair sex (Table 5.1) each of which allowed for different reporting biases, and which also let us explore extra-pair sex by married and unmarried women.

Multilevel multivariate logistic regression models were used to test whether FGC status is a significant predictor of these extra-pair sex indicators when controlling for socioeconomic variables which have been shown to affect the prevalence of sexual activity (Okonofua et al., 2002;Van Rossem and Gage, 2009;Smolak, 2014;Mpofu et al., 2016). These control variables were included as appropriate in the different models depending on the outcome variable; religion (Muslim/Christin or other), education (none/some), residence type (urban/rural), woman's age at survey, woman's age at first marriage, woman's age at first sex, descent pattern (matrilineal/patrilineal), household wealth (quintiles), and marital status. Household wealth is not included in models relating to married women as this variable reflects household wealth, which for married women relates to their husband rather than their natal wealth.

To test whether more extreme forms of FGC have a greater impact on extra-pair sex we ran the same 6 models for the different extra-pair sex indicators but replaced FGC status (no, yes) with FGC type as categorised by the DHS ('skin nicked', 'flesh removed', 'sewn closed', and 'type unknown').

We also performed a simple bivariate Pearson correlation to examine the relationship between the prevalence of FGC and the prevalence of the extra-pair sex indicators by ethnic group. If FGC is associated with reduced sexual behaviour the correlation would be negative.

Table 5.1 Extra-pair sex indicators: calculation and sample criteria

	Indicator	Sample	Calculation	Notes
PREMARITAL	Sex before marriage	All ever-married women	Calculated from age at first marriage and first intercourse, both in whole years.	This is a conservative measure as premarital sex in the year of marriage is not identified as such.
	Sex 2 years + before marriage	All ever-married women	Calculated from age at first marriage and first intercourse, both in whole years.	This indicator further reduces the probability that reported intercourse before marriage was with the woman's ultimate husband and therefore not extra-pair sex.
	Sex before marriage	All never-married women	All never-married women who gave a date of first intercourse.	
	Childbirth before marriage	Unmarried women who have given birth or are pregnant, plus married women	Married women whose age at first birth was lower than age at first marriage (in months).	This indicator removes reporting bias associated with underreporting of sexual activity. However, as not every incidence of sexual intercourse results in pregnancy this will underestimate absolute levels of sexual activity.
EXTRAMARIAL	Sex other than husband in preceding 12 months	All women who have been married for the preceding 12 months or more.	Calculated from number of self-reported sexual partners excluding husband, in the 12 months preceding the survey.	Only 3.0% women reported extramarital sex in preceding 12 months. This is highly sensitive and most likely to be subject to underreporting bias due to social sanctions and risk of divorce.
GENERAL	2 or more lifetime sexual partners	All sexually active women, excluding women who are divorced/widowed or have married more than once.	Calculated from respondents self-reported lifetime number of sexual partners.	Includes married and unmarried women.

5.2.3 Methods Hypothesis 2: Women with FGC marry earlier than women without FGC

Multilevel Cox (proportional hazard) regression models were performed to examine the association between FGC status and age at first marriage. Cox regression is an event history analysis which examines the association between different variables upon the time a specified event takes to happen. The model takes into account censoring i.e. not all individuals in the sample experience the event, which makes it preferable to a linear regression model examining age at first marriage. A hazard ratio (the exponent of the coefficient) over 1 indicates that the predictor variable is associated with a shorter time to event (Mills, 2011). In our model the specified event was marriage, the time was age (in years and months), and the model incorporated the marital status (married/unmarried) of women at each age. The model controlled for socioeconomic variables known to affect women's age at first marriage; religion (Muslim/Christian or other), age, type of residence (urban/rural) and education (none/some)

(Larsen and Yan, 2000;Boyden et al., 2012). The model also controlled for FGC frequency in the woman's ethnic group as the social norms within the marriage group may affect marriage preferences (Howard and Gibson, 2017;Shell-Duncan et al., 2011). All women with data for the control variables were included in the analysis (n 48,231).

5.2.4 Methods Hypothesis 3: Men with high paternity concern are more likely to marry a first wife with FGC

Multilevel multivariate logistic regression analysis was used to test this hypothesis in which the outcome variable of interest is the FGC status of a man's first/only wife, and indicators of paternity concern were included in the model in addition to control variables. The DHS survey does not include direct questions about men's paternity concern, therefore we systematically reviewed all available variables to identify those which could be used to create individual-level and ethnic group-level proxies for paternity concern. Previous studies have shown that group-level norms are important determinants of behaviour (Howard and Gibson, 2017). Individual-level proxies include factors which prevent men from 'mate-guarding' (absent ever, and absent for more than one month during the 12 months preceding the survey), whether the man is polygamous, and the man's personal sexual experience (incidence of premarital sex, and lifetime number of sexual partners) which could influence his assessment of women's sexual activity. Ethnic group-level proxies concern sexual activity by men and women within the man's ethnic group; prevalence of premarital sex and extra-marital sex, and the average number of lifetime sexual partners. These indicators were calculated from the wider population and varied substantially between ethnic groups (Appendix Table 5.2). As the individual and ethnic group-level proxies are confounded, several models were performed adding each experimental variable separately to the control variables.

To remove differences in marriage preference which may be due to wife rank in polygamous or second marriages, only couples comprising a man and his first wife (whose FGC status is known) were included in the analysis. This gave a sample of 10,693 couples across the five countries. The probability of marriage to a woman with FGC is highly correlated with the FGC prevalence in a man's ethnic group, as within ethnic group marriages are predominant (see 2.1 above). The multilevel model allowed FGC prevalence at the ethnic group level to be controlled for as a level 2 contextual variable. Additionally, the multilevel model controlled for individual male variables; age at survey, age at marriage, wealth (quintiles), education (none/some), religion (Muslim/Christian or other), and residence type (urban/rural).

We also tested three variations of the basic multilevel model: 1) A model which only included ethnic groups in which FGC prevalence ranges from 20% - 80% as marriage choices may reflect availability rather than preference in groups where FGC prevalence is close to 0% or 100%. This model excluded 20

ethnic groups, leaving 27 ethnic groups (n 6,850); 2) A model which excluded the Ivory Coast. There are a number of anomalies found in the Ivory Coast which could affect the results; the level of reported sexual activity among men and women is substantially higher than in the other countries (Appendix Table 5.2), and four out of the eleven ethnic groups are matrilineal (n398 out of 1081); and 3) a model with matrilineal ethnic groups only, to explore expected levels of paternal investment as a proxy for paternity concern. D:Place (https://d-place.org) was used to identify ethnic group descent pattern as this is not collected by the DHS. Just 6.0% of the couples in the sample are from matrilineal groups (n 639, 7 ethnic groups) with a range of FGC prevalence of 1.4% - 84.4%.

SPSS v23 was used for single level modelling, and MLwiN v3.01 was used for multilevel modelling.

5.3 RESULTS

5.3.1 Results Hypothesis 1: Women with FGC are less likely to have extra-pair sex

The multilevel logistic regression results (Table 5.2) show that a woman's FGC status is not a significant predictor of any of the four indicators of premarital sex; sex before marriage (OR 0.937, 95%CI(0.869-1.009) p=0.081), sex 2 years before marriage (OR 0.989, 95%CI(0.907-1.078) p=0.951), unmarried sex (OR 1.097, 95%CI(0.985-1.222) p=0.113), or childbirth before marriage (OR 1.113, 95%CI(0.970-1.279) p=0.128). Likewise, a woman's FGC status is not a significant predictor of whether a woman had extra-marital sex in the preceding 12 months (OR 1.031, 95%CI (0.868-1.227) p=0.175). However, women with FGC do have significantly lower odds of having more than one sexual partner in their lifetime (OR 0.821, 95%CI (0.756-.0881) p<0.000). In all models the ethnic group level variance is significant (p<0.000) whereas the country level variance is not. This suggests that ethnic group affinity is a stronger predictor of these behavioural outcomes than country affinity.

Table 5.2 Multilevel multivariate logistic regression analysis investigating the odds of different extra-pair sex indicators among female respondents aged 15-49 years

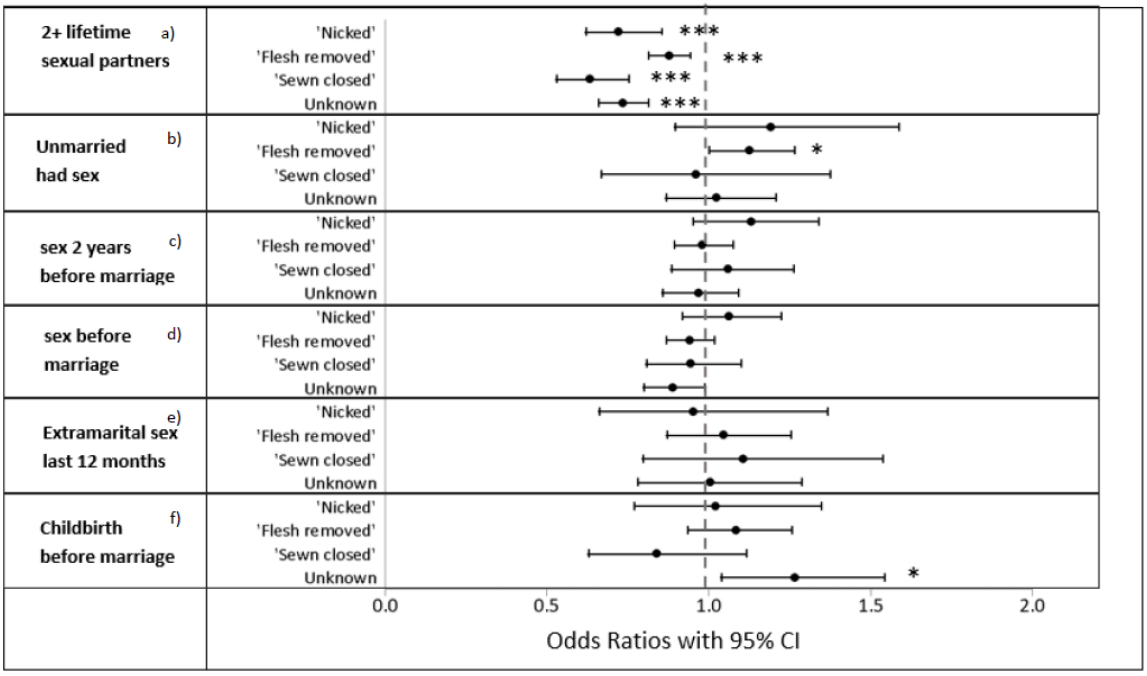
	PREMARITAL										EXTRAMARITAL			GENERAL		
	Sex before marriage			Sex 2 or more years before marriage			Unmarried women who have had sex			Childbirth before marriage			Extramarital sex during previous 12m			2 or more lifetime sexual partners		
Sample	n 40,585			n 40,585			n 12,395			n 41,196			n 38,838			n 39,164		
Women with outcome:	25.5% n 10,346			18.5% n 7,502			35.0% n 4,448			7.0% n 2,915			3.0% n 1,167			24.2% n 9,476		
Fixed effects	OR	(95% CI)	p	OR	(95% CI)	p	OR	(95% CI)	p	OR	(95% CI)	p	OR	(95% CI)	p	OR	(95% CI)	p
FGC (No FGC)	0.937	(0.869-1.009)	0.081	0.989	(0.907-1.078)	0.951	1.097	(0.985-1.222)	0.113	1.113	(0.970-1.279)	0.128	1.031	(0.868-1.227)	0.715	0.821	(0.756-0.881)	0.000
Some education (none)	1.179	(1.102-1.264)	0.000	1.195	(1.103-1.295)	0.000	1.153	(1.009-1.317)	0.047	1.438	(1.273-1.623)	0.000	3.497	(3.019-4.051)	0.000	2.206	(2.035-2.390)	0.000
Rural (urban)	0.888	(0.835-0.943)	0.000	0.954	(0.889-1.023)	0.191	0.841	(0.743-0.951)	0.002	0.788	(0.843-1.163)	0.899	0.406	(0.355-0.465)	0.000	0.634	(0.594-0.676)	0.000
Muslim (Christian other)	0.817	(0.751-0.886)	0.000	0.798	(0.725-0.878)	0.000	0.875	(0.767-0.998)	0.046	0.990	(0.959-0.970)	0.000	0.604	(0.492-0.739)	0.000	0.754	(0.695-0.859)	0.000
Matrilineal (patrilineal)	0.867	(0.453-1.658)	0.666	0.918	(0.482-1.745)	0.496	1.178	(0.545-2.545)	0.676	1.212	(0.756-1.945)	0.415	1.355	(0.745-2.464)	0.315	0.972	(0.418-2.258)	0.948
Age at survey	0.976	(0.972-0.980)	0.000	0.977	(0.973-0.981)	0.000	1.240	(1.216-1.264)	0.000	0.964	(0.706-0.879)	0.000	0.959	(0.951-0.966)	0.000	1.013	(1.009-1.017)	0.000
Age at 1st marriage	1.290	(1.277-1.307)	0.000	1.381	(1.359-1.403)	0.000	..	..	..	1.608	(1.579-1.636)	0.000	1.009	(0.989-1.029)	0.409	..	..	..
Age at 1st intercourse	..	..	..	..	..	..	..	..	..	0.616	(0.603-0.631)	0.000	0.932	(0.905-0.960)	0.000	0.906	(0.895-0.916)	0.000
Ever married (never)	..	..	..	..	..	..	..	..	..	..		..	..	..	..	0.623	(0.623-0.741)	0.000
Wealth (5-point scale)	..	..	..	..	..	..	0.933	(0.890-0.978)	0.508	..	..	..	..	..	..	..		..
Random effects	**Variance**	**(S.E.)**	**p**	**Variance (S.E.)**		**p**	**Variance (S.E.)**		**p**	**Variance (S.E.)**		**p**	**Variance (S.E.)**		**p**	**Variance (S.E.)**		**p**
Ethnic group variance	0.507	(0.116)	0.000	0.481	(0.112)	0.000	0.629	(0.156)	0.000	0.211	(0.058)	0.000	0.353	(0.097)	0.000	0.885	(0.200)	0.000
Country variance	0.639	(0.439)	0.150	0.821	(0.556)	0.140	1.426	(0.956)	0.136	0.273	(0.192)	0.155	0.177	(0.145)	0.313	0.641	(0.473)	0.175
Ethnic group ICC	13.3%			12.8%			16.1%			6.0%			11.0%			21.2%		
Country ICC	23.3%			20.0%			30.2%			7.7%			15.4%			16.1%		

Notes:

1) Individual sample size varies, but for all models level 2 (ethnic group) n=47, and level 3 (country) =5
2) See methods Section 5.2.2, Table 5.1, for inclusion criteria and calculation of outcome variables for each model
3) The reference category is given in brackets for categorical variable
4) Not all predictor variables are relevant to all models, see methods Section 5.2.2
5) ICC is the intra-class correlation coefficient, also known as the variance partition coefficient. This gives a measure of the variance in outcome attributable to the different levels in the model. The remaining unexplained variation is due to individual-level factors.

The models examining the association with FGC type showed that FGC type is not a strong differentiator of most indicators of extra-pair sex (illustrated in Figure 5.1, full model shown in Appendix Table 5.3). Women with all types of FGC have significantly lower odds of having more than one lifetime sexual partner compared to women without FGC and women who are 'sewn closed' have the lowest odds ('nicked' OR 0.720, 95%CI(0.620-.0855) p<0.000, 'flesh removed' OR 0.875, 95%CI(0.813-0.943) p<0.000, 'sewn' OR 0.631, 95%CI(0.528- 0.75) p<0.000 and unknown OR 0.732, 95%CI(0.660-0.812) p<0.000). The other indicators of sexual activity show no significant difference between women with different FGC types, with just two exceptions; unmarried women with 'flesh removed' have higher odds of having had sex (OR 1.125, 95%CI(1.000-1.266) p=0.050) and women with unknown FGC type have higher odds of birth before marriage (OR 1.265, 95%CI(1.038-1.542) p=0.019).

Figure 5.1 Odds ratio plot with 95% confidence intervals showing the results of multilevel multivariate logistic regression results examining the association with FGC type and different indicators of extra-pair sexual activity



*** p<0.001, ** p <0.001, * p<0.05
Sample sizes: a) 40,585 b) 40,585 c) 12,395 d) 41,996 e) 38,838 f) 39,164
Odds ratios shown are compared to reference category of No FGC
Full models see Appendix Table 5.3

Bivariate Pearson's correlation was used to examine the relationship between the prevalence of FGC and the prevalence of extra-pair sexual activity by women at the ethnic group level (n 47). The results show that there is a small but significant negative correlation for all three indicators i.e. with higher prevalence of FGC in the ethnic group, the proportion of women engaging in extra-pair sex

decreases (premarital sex r=-0.316, p=0.031, extramarital sex: r=-0.373, p=0.010, average number of sexual partners: r=-0.379, p=0.009). Analysis by country shows that the correlations are not significant in Mali, Senegal, Nigeria and Burkina Faso and that the overall result is being driven by the significant negative correlations in Ivory Coast ethnic groups (n 11) for all three indicators (Appendix Table 5.4).

5.3.2 Results Hypothesis 2: Women with FGC marry earlier than women without FGC

The Cox regression model results show that women with FGC are at a significantly higher hazard for first marriage i.e. married earlier, than women without FGC after controlling for socioeconomic variables and FGC prevalence (HR 1.113, 95%CI (1.085-1.142) p<0.000). Women with FGC have an 11.3% higher hazard of being married at every age than women without FGC, when keeping the control variables constant. The country and ethnic group variance in age at first marriage are very low, indicating that the majority of the variance is explained by individual-level variables (see Table 5.3).

Table 5.3 Multilevel cox regression hazard model predicting age at first marriage for women aged 15-49 years

CONTROLS	B	S.E.	HR	95% CI	p value
Fixed effects					
FGC (No FGC)	0.107	0.013	1.113	1.085- 1.142	0.000
Age at survey	-0.292	0.001	0.971	0.745- 0.748	0.000
Religion (other religion/Muslim)	0.117	0.015	1.125	1.092- 1.158	0.000
Rural (urban/rural)	0.238	0.011	1.269	1.242- 1.296	0.000
Education (none/some)	-0.363	0.012	0.696	0.679- 0.712	0.134
Contextual variables					
Ethnic FGC%	-0.152	0.141	0.859	0.652- 1.132	0.280
Random effects					
Ethnic group variance	0.064	0.259			
Country variance	0.031	0.175			
Ethnic group ICC		1.9%			
Country ICC		0.1%			

Individuals (n 42,381), Ethnic group (n 47), Countries (n 5)
Reference categories for categorical variables are underlined

5.3.3 Results Hypothesis 3: Men with high paternity concern are more likely to marry a first wife with FGC

The multilevel level logistic model results (Table 5.4) show that most individual-level proxies for paternity concern do not have a significant association with the FGC status of a man's first wife (Models 1-5), after controlling for individual SES variables and ethnic FGC prevalence. The exception is sex before marriage (Model 3) which is associated with higher odds of having a wife with FGC (OR

1.135, 95%CI (1.000-1.290) p=0.026). However, the ethnic group-level proxies of sexual activity by men and women all have a strong positive significant association with the odds of a man having a wife with FGC (Models 6-11). Models 6 and 7 show that with every increase in the average number of sexual partners by women in the ethnic group the odds of having a wife with FGC increases by 81%, and for men the odds increase by 10%. Models 8-11 show the effect of prevalence of premarital and extramarital sex by men and women within the group. The results shown are for 1% prevalence, so to apply this to any individual ethnic group the results must be multiplied by the actual ethnic group prevalence of the behaviour (See Appendix Table 5.3). For example, in an ethnic group where 50% of men have had premarital sex (Model 8), the odds of a man in that ethnic group having a first wife with FGC is 1.822 (exp(0.012 x 50) or 82.2% higher.

The prevalence of extramarital sex within the ethnic group has a stronger association (men OR 1.031, 95%CI(1.015-1.048) p<0.000; women OR 1.034, 95%CI(1.013-1.054) p<0.000) than the prevalence of premarital sex (men OR 1.013, 95%CI(1.002-1.022) p=0.006; women OR 1.015, 95%CI(1.005-1.025) p=0.001), although the prevalence of either behaviour among men or women in the ethnic group has a similar association. However, the average number of sexual partners by women compared to men in the ethnic group has a much larger association (men OR 1.100, 95%CI (1.042-1.163) p=0.001; women OR 1.813, 95%CI (1.302-2.525) p,0.000).

The variations to the basic multilevel models tested were as follows; the models which only included ethnic groups where the FGC prevalence ranged from 20-80% showed the same pattern of results as Table 5.4 with almost no difference in effect size or significance (Appendix Table 5.5); excluding individuals from Ivory Coast from the model also made no difference to the effect size or significance. However, the model which only included matrilineal groups showed that most ethnic group proxies of sexual activity had a smaller and non-significant association with the odds of a man marrying a wife with FGC than in the full model, and only premarital sex % (men) (OR 1.077, 95%CI (1.046-1.109) p<0.001) is a significant predictor of men from matrilineal groups having a wife with FGC (Appendix Table 5.6).

Table 5.4 Results of multilevel logistic regression models examining variables associated with the FGC status of a man's first wife; experimental variables were added to the control variables in separate models.

CONTROLS		B	S.E.	OR	95% CI	p value
Individual Male SES variables						
Age		0.022	0.003	1.022	(1.016 -1.028)	0.000
Religion (<u>other religion</u>/Muslim)		0.655	0.078	1.873	(1.652 -2.243)	0.000
Rural (<u>urban</u>/rural)		0.145	0.071	1.161	(1.006 -1.329)	0.039
Age at marriage		-0.019	0.005	0.981	(0.972 -0.991)	0.000
Education (<u>none</u>/some)		-0.112	0.070	0.903	(0.779 -1.026)	0.134
Wealth (increasing 5-point scale)		-0.140	0.027	0.873	(0.825 -0.917)	0.000
Polygamous (<u>no</u>/yes)		0.039	0.074	1.037	(0.899 -1.202)	0.625
Contextual variables						
Ethnic FGC%		0.059	0.003	1.060	(1.055 -1.067)	0.000
EXPERIMENTAL VARIABLES						
Proxies for paternity concern: Individual male variables (level 1)						
Model 1. Away last 12 months (<u>no</u>/yes)		0.037	0.059	1.037	(0.924 -1.165)	0.211
Model 2. Away for 1m+ (<u>no</u>/yes)		0.097	0.078	1.101	(0.946 -1.284)	0.639
Model 3. Premarital sex (<u>no</u>/yes)		0.127	0.065	1.135	(1.000 -1.290)	0.026
Model 4. Extramarital sex (<u>no</u>/yes)		0.082	0.105	1.085	(0.884 -1.333)	0.432
Model 5. No. sexual partners in lifetime		0.001	0.003	1.001	(0.995 -1.007)	0.629
Proxies for paternity concern: Ethnic group variables (level 2)	Range					
Model 6. Av. no. sexual partners (men)	2.3 - 9.1	0.096	0.028	1.100	(1.042 -1.163)	0.001
Model 7. Av. no. sexual partners (women)	1.2 - 3.9	0.595	0.169	1.813	(1.302 -2.525)	0.000
Model 8. Premarital sex % (men)	12-93%	0.012	0.005	1.013	(1.002 -1.022)	0.006
Model 9. Premarital sex % (women)	0-71%	0.015	0.005	1.015	(1.005 -1.025)	0.001
Model 10. Extramarital sex % (men)	1-59%	0.031	0.008	1.031	(1.015 -1.048)	0.000
Model 11. Extramarital sex % (women)	1-35%	0.033	0.010	1.034	(1.013 -1.054)	0.000

Notes:

1) Level 3: Country n 5, Level 2: Ethnic group n 47, Level 1: Couples n 10,695
2) The experimental variables were added separately to the model in addition to the control variables; the effects shown above are individual not cumulative. The significance of the control variables did not change with the addition of any of the experimental variables, the results shown here are for the control variables alone.
3) Sexual behaviour by ethnic group are shown in detail in Appendix Table 5.2.
4) Reference categories for categorical variables are underlined

5.4 DISCUSSION

5.4.1 Hypothesis 1: Women with FGC are less likely to have extra-pair sex

Our results do not support the hypothesis that FGC reduces extra-pair sex uniformly, rather they reveal how FGC status is associated with different indicators of extra-pair sex. Women with FGC do not have lower odds of engaging in premarital sex or extramarital sex than women without FGC. These findings are in line with previous studies (Odimegwu and Okemgbo, 2000;Okonofua et al.,

2002;Msuya et al., 2002;Klouman et al., 2005;Yount and Abraham, 2007;Van Rossem and Gage, 2009;Smolak, 2014;Mpofu et al., 2016). Further, we do not find that increasing severity of FGC is significantly associated with reduced odds of women having premarital or extramarital sex. This novel finding contrasts with commonly held views, in particular, that infibulation prevents premarital sexual activity e.g. (Mackie, 1996).

However, women with all types of FGC are significantly less likely to report having had more than one sexual partner in their lifetime. The contrast of this result with the premarital and extramarital indicators is open to interpretation. One possibility is that families in which FGC is practised have cultural norms which permit premarital sex (particularly if with a potential future husband) but discourage sex with multiple partners. Our results show that FGC status is not associated with incidence of premarital sex, which therefore suggests that differences in sexual activity in relation to FGC status are due to socially learned attitudes to sex rather than physiological consequences of the FGC procedure. Under this interpretation FGC does not predictably inhibit sexual function, but does covary with marital fidelity.

In view of our findings that FGC status does not predict women's premarital sexual behaviour, it is interesting that the opposite perception is widespread among policy makers (UNICEF, 2013;Adongo et al., 1998;Skaine, 2005;Mackie, 1996). By contrast, local views reflect our results; in four of the study countries (Mali, Nigeria, Burkina Faso and Ivory Coast) the DHS survey also collected opinions about FGC, showing that just 4 – 24% of men agreed that FGC prevents premarital sex and 4 – 13% of women (Appendix Figures 5.1a and 5.1b). However, local views are not necessarily accurate, and data are available from Mali and Nigeria data which allow comparison of the actual incidence of women's premarital sex with men's opinion that FGC prevents premarital sex, by ethnic group. Our analyses indicate that men's perceptions are not aligned with actual incidence (i.e. it is not the case that more men think FGC prevents premarital sex in ethnic groups where fewer women with FGC have premarital sex) (Appendix Figure 5.2). However, perceived risk of infidelity may be more important than women's actual behaviour in determining marriage preferences.

5.4.2 Hypothesis 2: Women with FGC marry earlier than women without FGC

The Cox regression results confirmed the hypothesis and showed that after controlling for ethnic FGC prevalence and socioeconomic profile, women with FGC have a significantly higher hazard of marrying at a younger age than women without FGC. These results lend support to the idea that women with FGC may be preferred as marriage partners (Sakeah et al., 2006;Kaplan et al., 2013a). The positive association with a woman's FGC status means that even in ethnic groups where having

FGC is not the norm (i.e. where you wouldn't expect women with FGC to be preferred) women with FGC get married earlier.

It has been shown that publicly stated opinions regarding FGC may understate true levels of support for the practice (Gibson et al., 2018). This may explain the difference between men's higher support for FGC abandonment described in the literature (Varol et al., 2015) (and see Appendix Figure 5.1b), and the results found here which seem to indicate a preference for marriage to women with FGC. The FGC status of men's wives is likely to be a better measure of their views on FGC than hypothetical data on attitudes to FGC typically recorded in surveys.

Marrying a woman with FGC and marrying a younger woman have both been linked to paternity concern, as both factors theoretically increase the chances that a woman will not have had sex at marriage (Hartung, 1985;Voland, 1998). Men with high concern about paternity may be reducing their risk by marrying a younger woman who also has FGC. However, these marriage preferences may also be motivated by the wife's reproductive potential. Starting reproduction at a younger age increases a woman's fitness (Allal et al., 2004), and women with FGC have been shown to have higher evolutionary fitness (Gruenbaum, 2000;Reason, 2004).

5.4.3 Hypothesis 3: Men with high paternity concern are more likely to marry a first wife with FGC

Using multilevel logistic models we examine how proxies for paternity concern at individual and group-level affect the odds of a man's first wife having FGC. Few of the individual-level proxies for paternity concern (absence from home, polygamy, men's own sexual activity) had a significant impact on the FGC status of a man's first wife in the model. This may be because the proxy variables used are not reliable indicators of pre-conceptual paternity concern (e.g. level of absence from home may have changed since marriage) but may also reflect that a man's own sexual activity is not a cue for paternity concern.

The ethnic group-level contextual proxies for paternity concern show a very strong positive association with the FGC status of a man's first wife, while holding FGC prevalence in the ethnic group constant. These results suggest that men are responding to the levels of sexual activity within their ethnic group, and where the risk of a man's partner engaging in extra-pair sex appears higher, men are more likely to marry a first wife with FGC. The stronger association between the prevalence of extramarital compared to premarital sex within the ethnic group provides further support that men are responding to the higher risk of extra-pair sex during marriage. In addition, the stronger association between women's average number of sexual partners compared to men's supports the

paternity certainty hypothesis. Restricting our sample to matrilineal groups, we find few of the ethnic group-level sexual activity indicators have a significant impact on the odds of men having a wife with FGC (Appendix Table 5.6). This supports the prediction that paternity concern (or lack of it, as is believed to be the case in matrilineal societies (Holden et al., 2003)) may affect men's marriage choices.

Our findings are consistent with behaviour predicted by the paternity certainty theory, however, whether these marriage choices result in higher evolutionary fitness is unknown. Here we used self-reported extra-pair sexual activity to gauge the risk of misplaced paternal investment, however DNA testing would be required to establish whether non-paternity rates are any different for men whose wives have FGC. To accommodate for the possibility that self-reported sexual activity levels may be inaccurate, we used three different indicators of group sexual activity, which are calculated from a number of data points for both men and women (Dare and Cleland, 1994;Nnko et al., 2004). However, men's perceptions of sexual activity within the marriage pool may be more important than the reality in their assessment of the risk of extra-pair sex. If men are over-reporting their sexual activity levels to survey interviewers, it is possible they are doing the same when talking with their peers.

While the results here suggest that men are making context-dependent marriage choices potentially motivated by paternity concern, in reality women are making choices too and many factors not covered by the DHS surveys influence the negotiations and economics of marriage. For example, bridewealth payments at marriage (from the groom to the bride's family) are common in West Africa, and may influence support for FGC (Groszngate, 1988;Hampshire and Smith, 2001;Mondain et al., 2007;Calv et al., 2007). The relationship between FGC status and bridewealth negotiations is not well understood, and has only been the subject of a few studies; finding that bridewealth payments can be dependent on a woman having FGC, or that bridewealth can be of higher value if the bride has FGC (Shell-Duncan et al., 2000;Apostolou, 2008). Likewise, family involvement is very important in West Africa where marriages are often arranged by the couples' parents or relatives (Mair, 2013). Cross-cultural studies have shown that parental rather than individual choice can be more influential in partner selection (Apostolou, 2008). This wider network of individuals involved in partner choice may result in competing evolutionary drivers. Parents' marriage preferences will often be aligned with their offspring's, but they may diverge, for example due to marital residence patterns or family composition (Trivers, 1974).

Alternative explanations for the marital preferences for men tested in Hypothesis 2 and 3 could include some phenotypic variation associated with FGC status which influence women's age at

marriage and/or opportunity for marriage, but which are not captured in the data. One example could be religiosity; we have controlled for religious group, but not for variation in piety or devoutness. Likewise, men and their families may be selecting women for marriage based on some cultural trait which confounds with FGC status (e.g. using FGC as a cultural indicator of fidelity as suggested by results testing Hypothesis 1, Section 5.3.1).

5.5 CONCLUSION

In this study DHS datasets from five West African countries were used to test the often-stated yet unproven theory that paternity certainty is driving the persistence of FGC. This assumes that FGC impairs women's sexual function and reduces the probability of women having extra-pair sex, which in turn leads men to prefer marriage to women with FGC, particularly men with higher paternity concern. Support was found for some but not all the assumptions tested. In our sample, having FGC does not reduce the odds of women having premarital extra-pair sex, although it does reduce the odds of women having more than one lifetime sexual partner. We find that women with FGC get married at a younger age, which may be an indicator of marriage preferences for men. The strongest support for the paternity certainty theory comes from the multilevel model results examining the odds of marrying a woman with FGC. This shows that men living in ethnic groups with higher levels of reported extra-pair sexual activity (and potentially a higher risk of unknowingly raising another man's offspring), have greater odds of marrying a first wife with FGC. This suggests that marriage choices made by men and their kin are context-dependent and may be influenced by sexual norms of the group in which they live.

While we do not find that FGC is universally associated with reduced extra-pair sex for women, our results suggest that FGC status does improve women's marriage opportunities, particularly where the incidence of extra-pair sex is higher. This apparent disparity raises some interesting questions. If marriage preferences for men are based on inaccurate beliefs that FGC increases women's sexual fidelity, why or how are these incorrect perceptions perpetuated? If FGC is a cultural marker signalling sexual fidelity, either to potential marriage partners or to other women as a sign of non-competition, this could be advantageous for women (Wilson, 2008). The disparities we have identified challenge whether paternity concern is the only explanation for the marriage preferences found here. It is possible that some behavioural or phenotypic characteristic not captured in our analysis such as religiosity or social status, which varies with FGC status, may better explain these results.

A further element of the paternity certainty theory of FGC (not tested here) is that marriage preferences of men (and their patrikin) encourage families to have their daughters cut which

indirectly perpetuates the practice. In contexts where women's socioeconomic security is often dependent on marriage, parents are motivated to ensure that their daughters attract marriage partners. In addition to enhanced marriageability, we speculate that FGC could also enhance women's reproductive success. If men are more convinced of their own paternity when married to women with FGC, they may invest more in their offspring. This extra investment could improve offspring survival, as would a lower incidence of child abuse, neglect and mortality which is also associated with higher paternity confidence (Daly et al., 1982). This potential for enhanced reproductive success for women with FGC may be part of the functional explanation for parental decisions over having FGC performed on their daughters (Tinbergen, 1963).

There are multiple documented reasons for having FGC performed, which at the proximate level include social acceptance, cleanliness, tradition and religion (Shell-Duncan, 2004). Previously, it has been shown how cultural and evolutionary forces may combine to influence the popularity of the practice (Howard and Gibson, 2017). Here we demonstrate the importance of FGC for women's marriage opportunities, most notably in contexts where the risk of extra-pair sex is higher. The results suggest that paternity certainty cannot be ruled out as a factor contributing to the maintenance of female genital cutting in these five West African countries.

CHAPTER 6 FREQUENCY-DEPENDENT FEMALE GENITAL CUTTING BEHAVIOUR CONFERS EVOLUTIONARY FITNESS BENEFITS[2]

Abstract

Female genital cutting (FGC) has immediate and long-term negative health consequences that are well-documented, and its elimination is a priority for policy makers. The persistence of this widespread practice also presents a puzzle for evolutionary anthropologists due to its potentially detrimental impact on survival and reproductive fitness. Using multilevel modelling on Demographic Health Survey (DHS) datasets from 5 West African countries, here we show that FGC behaviour is frequency-dependent; the probability that girls are cut varies in proportion to the FGC frequency found in their ethnic group. We also show that this frequency-dependent behaviour is adaptive in evolutionary fitness terms; in ethnic groups with high FGC frequency women with FGC have significantly more surviving offspring than their uncut peers and the reverse is found in ethnic groups with low FGC frequency. Our results demonstrate how evolutionary and cultural forces can drive the persistence of harmful behaviours.

Female Genital Cutting (FGC) is defined by the World Health Organisation (WHO) as "all procedures that involve partial or total removal of the external female genitalia, or other injury to the female genital organs for non-medical reasons" (WHO, 2014). The severity and context in which it is practised varies greatly, but the negative health consequences for women, particularly those with the more severe types of FGC (Almroth et al., 2005;Amin et al., 2013;Banks et al., 2006) include short-term (Iavazzo et al., 2013), long-term (Kaplan et al., 2011;Jones et al., 1999), obstetric (Banks et al., 2006;Berg and Underland, 2013), and psychological and sexual problems (el-Defrawi et al., 2001). Occurring in 29 countries in Africa and the Middle East, the frequency of FGC within ethnic groups varies from 1-99% (UNICEF, 2013). The persistence of this practice, especially in the face of longstanding eradication efforts, represents a puzzle to policy makers and evolutionary scientists alike (Askew, 2005;Jones et al., 2004;Vogt et al., 2016). As a seemingly costly behaviour, FGC challenges assumptions of adaptive behaviour as it appears to jeopardise rather than maximise evolutionary fitness (Davies et al., 2012).

[2] This chapter was co-authored with Mhairi A. Gibson. Here the paper appears with minor amendments to the published version, with heading numberings adjusted for the thesis format. Howard, J.A. and Gibson, M.A., 2017. Frequency-dependent female genital cutting behaviour confers evolutionary fitness benefits. Nature ecology & evolution, 1(3), p.49.

Here we explore how evolutionary genetic and cultural forces may explain the persistence of FGC once established in a population. The relative importance of genetic versus cultural evolution in shaping human behaviour represents a long-standing debate within human evolutionary sciences (Mace, 2014). In this study we build on a growing body of work and integrate ideas from cultural evolution and behavioural ecology to identify how and why reproductive outcomes (fitness) of FGC may vary according to the local cultural context (Nettle et al., 2013;Laland and Brown, 2011;Mesoudi, 2011b;Richerson and Boyd, 2008).

Cultural evolution considers how human behaviours are socially transmitted (Mesoudi, 2011b;Richerson and Boyd, 2008;Laland and Brown, 2011). Positive frequency-dependent transmission is a well-established mechanism of social learning in which the probability that an individual adopts a behaviour depends on how common the behaviour is within a relevant group (Efferson et al., 2008;Boyd and Richerson, 1985). Conformity bias is a subset of positive frequency-dependent biases, where individuals are disproportionately likely to acquire the most common behaviour (Morgan and Laland, 2012). It often used as an explanation for the spread of neutral or maladaptive behaviours, as behaviours are adopted based on frequency without evaluation of merit. To date studies of conformity have mostly used modelling and experimental data, however positive frequency-dependent transmission is gaining popularity as an explanation for FGC persistence (Ross et al., 2015;Ross et al., 2016) and evidence of frequency-dependent maintenance of FGC has been found in one empirical study (Hayford, 2005).

Consideration of social mechanisms underpinning the persistence and abandonment of FGC have also been incorporated within development policy and practice (DFID, 2013;UNICEF, 2013;Mackie and LeJeune, 2009). A widely adopted explanation for FGC is based on coordination game theory and commonly known as the social convention theory (Mackie, 1996). This suggests that men and women are stuck in a self-enforcing convention where both believe FGC is essential for marriage. It proposes that to alter behaviour a coordinated effort is required among individuals from an intra-marrying population so that a critical mass reach a tipping point and switch together from a cutting to a non-cutting convention. Although influential in eradication programmes application of this theory to FGC behaviour has been challenged; a recent study found a range of cutting practices within intermarrying communities, inconsistent with a social convention norm (Efferson et al., 2015), and other studies found that access to women's social networks (Shell-Duncan et al., 2011) or women's individual or household variables (Bellemare et al., 2015) are more important in perpetuating FGC.

Behavioural ecology considers the ultimate mechanisms (Krebs and Davies, 2009;Tinbergen, 1963;Scott-Phillips et al., 2011) of behaviour and predicts that individuals will behave in a way that maximises reproductive success given their specific circumstances despite any negative effects this may have on their immediate well-being (Borgerhoff Mulder, 1991;Nettle et al., 2013). Behaviour is expected to lead to fitness maximisation within the constraints of the local ecology (including socio-ecology). Applying this to FGC, we would expect FGC to persist when the balance of the costs and benefits result in fitness benefits for those involved. Proposed benefits resulting from FGC include enhanced marriageability (Ross et al., 2016)) or membership of social networks with associated access to resources or support (Shell-Duncan et al., 2011). To date, only a few studies have explored the impact of FGC status on proxies for fitness, with mixed results; two studies found FGC to be associated with greater fertility (Reason, 2004; Gruenbaum, 2000) while another found a negative association between fertility and FGC (Balk, 2000). None of these studies explored the frequency-dependent nature of FGC.

6.1 DATA & METHODS (SEE EXTENDED METHODS BELOW FOR FURTHER DETAIL)

Here we test two predictions; 1) FGC is a frequency-dependent behaviour, and 2) there are fitness benefits associated with frequency-dependent FGC behaviour. We selected five Demographic and Health Surveys Program (DHS) datasets from West Africa according to specific inclusion criteria. (See Appendix Table 6.5 and Appendix Figure 6.1 for inclusion analysis and map). This provided data on 61,483 women with known FGC status from 47 ethnic groups, of whom 36,038 have one or more living daughter and provided information on their daughter(s)' FGC status. All individuals who met these criteria were included. Analysis (not presented here) showed that similar patterns were found when using the FGC prevalence in the mother or father's ethnic group as the predictor of interest; to maintain sample size mother's ethnic FGC prevalence was used. To test both predictions we performed single level analysis for ethnic groups from each of the five countries separately, as well as multilevel analysis which pooled the women's data from all five countries to examine individual variation. The three level model structure used individual women, nested in ethnic groups, nested in countries. In both single- and multi-level analyses the same dependent and independent variables were used.

To test the first prediction we used logistic regression to examine whether the FGC prevalence in a mother's ethnic group is significantly associated with the FGC status of her daughter(s). The dependent variable was a binary response of whether or not a mother has one or more cut daughter(s). The key independent variable of interest was the FGC frequency in the mother's ethnic group, controlling for the mother's own FGC status as well as a range of maternal variables that have

been found in previous studies to be significantly associated with the likelihood of a daughter being cut namely the mother's age, wealth, education and religion (Iliyasu et al., 2012;Ashimi et al.;Sipsma et al., 2012).

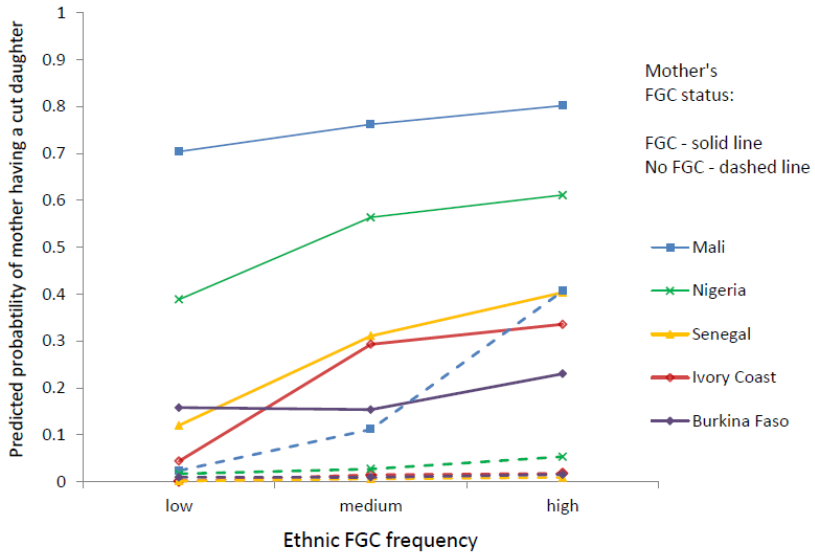
To test the second prediction we used linear regression to examine the relationship between ethnic FGC frequency and the relative fitness of women with and without FGC by ethnic group. We used the number of surviving offspring at age 40 as a proxy for fitness in the analysis, as the upper age limit of female respondents in DHS surveys is 49 years and few have completed lifetime fertility. This provided a sample of 10,067 women aged 40-49 years from 47 ethnic groups, who had given their FGC status. We performed a Pearson's correlation by country separately, to examine the relationship between ethnic FGC frequency and average number of surviving offspring for women with and without FGC in each ethnic group. We also performed a three level linear regression analysis controlling for individual level 1 variables; mother's FGC status, education, religion and wealth, and ethnic FGC frequency was added as a level 2 contextual variable. A cross-level interaction between FGC status and ethnic FGC frequency was included which allowed for the effect of FGC status to vary depending on FGC prevalence in the ethnic group. All analyses were undertaken using MLwiN version 2.35 and SPSS v23.

6.2 RESULTS

6.2.1 Prediction 1: FGC is a frequency-dependent behaviour

As FGC prevalence in the mother's ethnic group increases, the odds of the mother having a cut daughter also increases. The single-level logistic regression model showed that mother's FGC status is the strongest predictor, followed by ethnic FGC frequency, which is a significant predictor of whether a mother has a cut daughter when holding other variables constant in all five countries (OR, 95% CI; Nigeria 1.019 (1.014, 1.023), Senegal 1.013 (1.007, 1.018), Mali 1.024 (1.020, 1.028) , Burkina Faso 1.015 (1.007, 1.023), Ivory Coast 1.031 (1.020, 1.044), $p<0.001$ for all). See Appendix Table 5.1 for full results. With every 1% increase in FGC prevalence in the mother's ethnic group there is a 1.3% - 3.1% increase (depending on the country) in the odds of her daughter being cut which in areas of high FGC prevalence translates into a substantial increase in odds. The interaction plot (Figure 6.1) illustrates these results. In all five countries the probability of a mother having a cut daughter is higher where ethnic FGC frequency is high, both for women with FGC and to a lesser extent women without FGC, with the exception of Mali.

Figure 6.1: Predicted probabilities of having a cut daughter by mother's FGC status and country at different ethnic FGC frequencies.

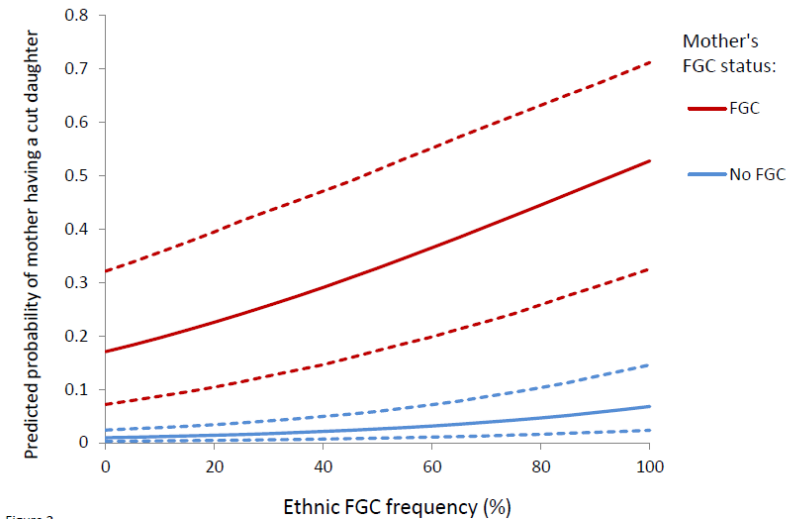


Predicted probabilities calculated from single-level logistic regression model controlling for mother's wealth, education, religion and age. In the model ethnic FGC frequency was a continuous variable, values are grouped into tertiles here for visual clarity. (Mali n7,634, Nigeria n7,916, Senegal n6,941, Ivory Coast n3,241, Burkina Faso n10,305).

Three-level logistic regression analysis exploring unobserved variation in whether a mother has a cut daughter (due to maternal, ethnic and country-level factors) reveals significant clustering at the ethnic group level (see Appendix Table 6.2 for full results). After controlling for both maternal and ethnic level factors there is significant variation in the odds of having a cut daughter across ethnic groups (u_{jk} = 0.241 S.E. 0.064) but not across countries (v_{jk} = 1.313 S.E. 0.848). The proportional change in variance across ethnic groups showed that much of the individual variance in log odds of having a cut daughter is explained by maternal factors (78%), but that inclusion of ethnic FGC prevalence improves the model fit and together explains 90% of the variance. The median odds ratios (MOR) at ethnic group level showed the same effect (see Appendix Table 6.2).

Allowing for variation within ethnic group and country, the multilevel logistic model also showed that ethnic FGC frequency is a significant predictor of whether a mother has a cut daughter when controlling for the mother's own FGC status as well as her age, wealth, religion and education (OR 1.022, 95% CI (1.015, 1.029)) (full results shown in the Appendix Table 6.2). In this model with every 1% increase in ethnic FGC prevalence, a mother has a 2.2% increase in the probability of having a cut daughter when holding these other variables constant. Figure 6.2 illustrates the predicted probabilities.

Figure 6.2: Predicted probabilities of having a cut daughter by mother's FGC status at different ethnic FGC frequencies.



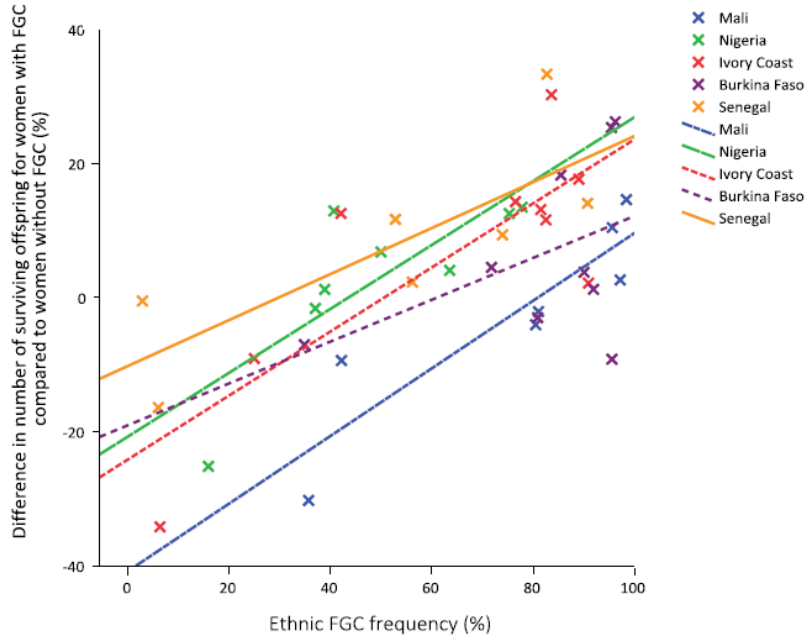
Predicted probabilities calculated from multilevel logistic regression model controlling for mother's wealth, education, religion and age. Dotted lines = 95% confidence intervals.
Level 1: individual n36,038, level 2: ethnic group n47, level 3: country n5

In support of previous studies having FGC, being Muslim and being older increases the odds of a mother having a cut daughter, whereas being educated and wealthy decreases the odds (Yoder and Wang, 2013a;Sipsma et al., 2012). Here we also show that ethnic FGC frequency is a significant factor in determining the probability that a mother will have a cut daughter.

6.2.2 Prediction 2: Fitness benefits associated with frequency-dependent FGC behaviour

The results from the single- and multi-level analysis demonstrate that fitness, measured by the number of surviving offspring at age 40 years, is increased by varying FGC behaviour in relation to ethnic FGC frequency. In all five countries the univariate correlation analysis showed a strong positive association between the ethnic FGC frequency and the percentage difference in the average number of surviving offspring for women with FGC compared to women without (see Table 6.1, illustrated in Figure 6.3). In ethnic groups with high FGC prevalence, on average women with FGC have more surviving offspring than women without FGC in the same ethnic group. Conversely, in ethnic groups with low FGC prevalence women without FGC have more surviving offspring on average. The average number of surviving offspring ranges from 5.4 – 7.3 among ethnic groups in this study therefore a 20% difference is equivalent to approximately one offspring (Figure 6.3).

Figure 6.3: Correlation between ethnic FGC Frequency and the percentage difference in average number of surviving offspring for women aged 40-49 with FGC compared to women without FGC



Sample size: Mali n1,650, Ivory Coast n847, Nigeria n2,274, Burkina Faso n 2,512, Senegal n1,866

Table 6.1: Pearson's correlation between ethnic FGC Frequency (%) and the percentage difference in average number of surviving offspring for women aged 40-49 in each ethnic group with FGC compared to women without FGC.

Country	Ethnic Groups n	Women n	Pearson's R	p value
Mali	7	1,650	0.899	0.006
Ivory Coast	9	847	0.804	0.009
Nigeria	8	2,274	0.793	0.016
Burkina Faso	9	2,512	0.445	0.279
Senegal	7	1,866	0.794	0.033

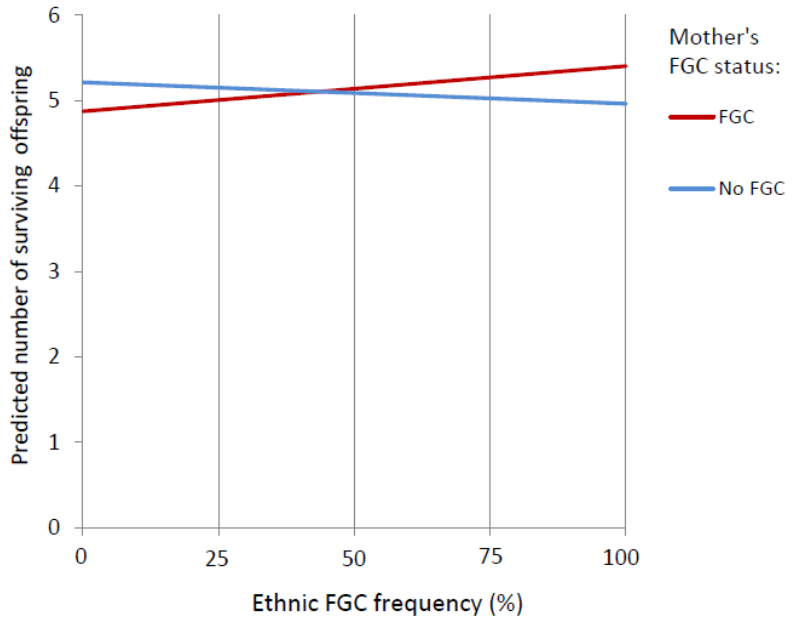
The cross-level interaction in the multilevel linear regression model allows for the effect of individual FGC status (level 1) to vary depending on FGC prevalence in the ethnic group (level 2) (Rasbash et al., 2012a) (Aguinis et al., 2013). This is significant when controlling for maternal characteristics (β 0.008, ± 0.003, p 0.005). The effect is illustrated in Figure 6.4 where the predicted number of surviving offspring are plotted for women with and without FGC over a range of ethnic FGC frequencies. As ethnic FGC frequency increases the fitness advantages shifts from women without FGC to women with FGC. In absolute terms women with FGC are predicted to have 0.34 fewer surviving offspring in ethnic groups with 0% FGC prevalence, and 0.44 more surviving offspring in ethnic groups with 100% FGC prevalence.

Table 6.2 Multilevel linear regression model analysing number of surviving offspring born to women aged 40-49

Parameter	β	S.E.	p value
Fixed Effects			
Constant	5.125	0.145	0.000
Mother's FGC status (No/Yes)	-0.339	0.188	0.070
Mother's education (None/Some education)	-0.409	0.066	0.000
Mother's wealth (lowest quintile)			
Second	-0.091	0.069	0.191
Third	-0.189	0.070	0.007
Fourth	-0.265	0.075	0.007
Highest	-0.743	0.070	0.000
Mother's religion (Christian or other/Muslim)	0.110	0.069	0.108
Contextual Effects			
Ethnic FGC (%)	-0.003	0.002	0.302
Cross level Interaction			
Ethnic FGC% x Mother's FGC status	0.008	0.003	0.005
Random Part			
Variance level 3 (Country)	0.000	0.000	0.998
Variance level 2 (Ethnic group)	0.139	0.038	0.000
Variance level 1 (Individual)	5.522	0.138	0.000

For categorical variables, the reference category is underlined

Figure 6.4: Predicted number of surviving offspring by mother's FGC status and ethnic FGC frequency



Predictions calculated from multilevel linear regression model controlling for mother's FGC status, religion, education and wealth. (level 1: individual n10,067, level 2: ethnic group: n47, level 3: country n5).

6.3 DISCUSSION

6.3.1 Frequency-dependent behaviour

We show in both single- and multilevel analysis that FGC frequency in the mother's ethnic group is a significant predictor of the odds of having a cut daughter, when controlling for maternal characteristics including mother's FGC status. In all five countries, the odds increase as the ethnic FGC frequency increases which supports our prediction that FGC is a frequency-dependent behaviour.

Both Figures 6.1 and 6.2 illustrate that the mother's FGC status is the strongest predictor, however the relationship between a mother's and her daughters' FGC status is not simply linear with mothers replicating their own status on their daughters. Women with FGC have a markedly lower probability of having a cut daughter in ethnic groups with low compared to high FGC frequency showing that they are responsive to local ethnic pressures. By contrast, women without FGC are unlikely to perpetuate FGC even when living in an ethnic group where FGC is highly prevalent suggesting that ethnic FGC frequency has less impact on their behaviour (with the exception of Mali). This implies that the forces of frequency-dependent learning may not work equally in both directions and that once the behaviour has been abandoned it may not be resumed even when individuals become exposed to high FGC prevalence, for example through migration or marriage.

6.3.2 Fitness benefits associated with frequency-dependent behaviour

We also show that frequency-dependent FGC behaviour confers evolutionary fitness benefits, as measured by the number of surviving offspring at age 40. Results from both the single and multi-level models demonstrate that in ethnic groups with high FGC frequency women with FGC have higher relative fitness while the reverse is true in ethnic groups with low FGC frequency. Further, that despite the negative health consequences, women with FGC are at a fitness advantage compared to women without FGC when living in ethnic groups where FGC is the majority behaviour.

Selection biases relating to biological phenotypic differences between women with or without FGC are unlikely to explain these results as a) women with FGC only have higher fitness in circumstances where FGC is the majority behaviour rather than universally, otherwise they have equal or lower fitness, b) excluding women with extreme FGC types which may be driving the fitness differences among high FGC ethnicities does not change the results (Appendix Table 6.3) and c) women with FGC are not taller (a proxy for well-being and associated with fertility (Sear et al., 2004;Allal et al., 2004)), and therefore does not account for the fitness differences seen here (Appendix Table 6.4). Further, there is enough variability in sex differences in infant and child mortality to demonstrate that there

is no clear mortality bias for girls that could be associated with the FGC procedure (Appendix Table 6.4). However, it is possible that maternal mortality associated with FGC could introduce bias and underestimation of the costs of FGC as women who died before age 40-49 are not included in the DHS surveys.

These frequency-dependent findings may explain the varied results from previous studies examining the association between proxies for fitness and FGC status, as FGC frequencies among local populations were not considered (Reason, 2004;Gruenbaum, 2000;Balk, 2000). Rather the results of this study reveal that women with FGC should only have higher reproductive success in populations where FGC is the dominant behaviour.

Figure 6.3 and Figure 6.4 show that at 50% ethnic FGC prevalence, women with and without FGC have similar fitness. Interestingly mid-range FGC prevalence is uncommon; in our sample only 4% of ethnic groups have an FGC frequency between 45-55%, and the same distribution is found among a further 18 DHS countries. This implies that prevalence in ethnic groups is moving toward either 0% or 100% and accordingly we suggest that eradication policy should seek to reduce prevalence among ethnic groups to less than 50%. If individuals are then disproportionately likely to acquire the most common behaviour FGC frequency will gradually reduce over time (Boyd and Richerson, 1985). Time series data, however, would be necessary to confirm this prediction.

6.4 CONCLUSION

In this study we show how female genital cutting, which is an often-used example of a costly behaviour in humans, can be adaptive in evolutionary fitness terms. We show that FGC is a frequency-dependent behaviour and that the benefits of FGC, measured by the number of surviving offspring, outweigh the costs in circumstances where FGC is dominant. It is striking that these positive frequency-dependent results are repeated in five countries with quite different contexts and FGC eradication efforts. To our knowledge this is the first study to demonstrate the fitness consequences associated with a frequency-dependent socially transmitted behaviour. We show that as the cultural context (ethnic FGC frequency) gradually changes, so too does behaviour, resulting in optimal fitness at both ends of the spectrum. Women who do not follow the majority behaviour appear to be at a fitness disadvantage, and conversely those who follow the majority behaviour are at a fitness advantage.

We argue that combined cultural-evolutionary forces underpin these effects. Responding to the majority behaviour could, for example, enhance the ‘mate value’ of women by increasing their desirability in the marriage market which may translate into higher fertility and/or improved child

survivorship (Gage and Van Rossem, 2006). Studies linking FGC status with early age at first marriage (Reason, 2004;Boyden et al., 2012) and age at first birth (Larsen and Yan, 2000) are supportive of this. Further, if FGC status provides entry into social networks with enhanced access to resources and support this may also improve fitness outcomes such as the health of women and their offspring (Shell-Duncan et al., 2011).

Understanding that frequency-dependent forces lead to the persistence of FGC, and that this may have fitness benefits, is a novel contribution to the debate in the evolutionary literature on how and why costly behaviours are perpetuated. These findings are also important for policy makers as they reveal why FGC, and similar costly behaviours, are resistent to change. Specifically, these results imply that FGC eradication initiatives based on the idea of a tipping point driving behavioural change may not be the only solution (DFID, 2013). Instead a piecemeal reduction of FGC by individuals can play a part in the decline of FGC prevalence in the overall population.

6.5 EXTENDED METHODS

6.5.1 Demographic and Health Surveys (DHS)

We used data from the Demographic and Health Surveys Program (DHS) which surveys large numbers of women across different countries in a comparable format. All respondents are read an informed consent statement before interview, following which they may accept or decline to participate. A parent or guardian provides consent prior to participation by an adolescent. Countries from West Africa, where FGC is highly prevalent, were included according to specific criteria; a) a recent DHS survey included the FGC module, b) the population exceeds 3 million for sample size purposes, and c) the FGC frequencies of ethnic groups within the country range from under to over 50%. This last criterion was essential to explore FGC behaviour and fitness consequences in a wide range of FGC frequencies. The following five datasets met these criteria; Ivory Coast 2011-12, Mali 2006, Nigeria 2008, Burkina Faso 2010 and Senegal 2013 which together provided data on 61,483 women from 47 ethnic groups. Female respondents in all DHS surveys are aged 15-49 years old, and are a representative sample by socioeconomic status and ethnicity. See Appendix Table 6.6 and Appendix Figure 6.1 for inclusion analysis and map.

Ethnicity was used as the relevant group or context for frequency-dependent analysis, as ethnic group has been shown to have a significant association with FGC prevalence (Yoder and Wang, 2013;Snow et al., 2002;Bellemare et al., 2015;Shell-Duncan et al., 2011) and provides an adequate sample size for analysis. Cluster and region were considered as alternative reference groups but rejected as neither are necessarily meaningful social groupings; regional divisions are often

arbitrarily drawn for administrative purposes, and clusters group together households within a similar radius of a specific GPS point but with unknown inter-relationships. Mothers' rather than fathers' ethnic group was used to maintain sample size. Interethnic marriage rates range from 8-27% although most interethnic marriages are between couples from ethnic groups with 10% or less difference in FGC prevalence. Ethnic groups found in multiple study countries were treated separately in the analysis as the individuals within them are subject to different legal and national pressures. At the time of these DHS surveys FGC was illegal in Ivory Coast, Burkina Faso, Senegal, but legal in Mali and some states of Nigeria. See Appendix Table 6.6 for a breakdown of respondents' FGC status by ethnic group and country.

Mothers and older female relatives are usually the main proponents of FGC and arrange a girl's FGC procedure, most commonly by a traditional practitioner (Kaplan et al., 2013a;Shell-Duncan, 2004). In West Africa, FGC is usually performed during infancy or before age five and in the five study countries 76-94% of girls with FGC were cut before age five (Yoder and Wang, 2013).

6.5.2 Statistical analysis

As noted above both single and multilevel models were used to test both predictions below. The data is well suited to multilevel regression models, with individual women nested in ethnic groups, nested in countries. This structure was used to explore individual and contextual ethnic level factors associated with the outcome variables. Recognising this clustering within a multilevel model distinguishes between the individual and higher-level variation avoiding incorrect inferences based on ecological fallacies (Pollet et al., 2015). However, although there is no consensus on sample size for multilevel analysis, it is generally recommended that it should be over 15 to avoid standard errors being underestimated (Rasbash et al., 2012). Here we have just 5 countries at level 3 and note there is a possibility that the country-level random variances and standard errors may be underestimated.

6.5.3 Prediction 1: FGC is a frequency-dependent behaviour

Here we test the prediction that there is a significant association between ethnic FGC frequency and the odds of a mother having a cut daughter. The survey asked women with at least one living daughter whether their daughter had been 'circumcised' (translated into the local term). In some countries the FGC status of every daughter was collected, and in others future intentions towards uncut daughters were collected, but to keep the data comparable across all five countries we used a single indicator of whether one or more daughters had been cut at the time of the survey. Ethnic FGC frequency was calculated as a percentage for each identifiable ethnic group in each country by

dividing the number of women with FGC by the total number of women who responded to the survey question on whether they had been circumcised. Those whose ethnic group was given as 'other' were excluded. In the model the input variables, including the FGC frequency in each ethnic group, concern only the mothers, and the outcome variable concerns their daughters. This resulted in 36,038 mothers from the 47 identifiable ethnic groups, who had at least one daughter and provided information concerning their own and their daughter's FGC status. All available data that met these criteria were used in the analysis.

The single level logistic regression by country included all predictor variables (ethnic FGC frequency, mother's FGC status, religion, education, wealth and age). In the three level logistic regression model (level 1: individual n36,038, level 2: ethnic group: n47, level 3: country n5) individual and contextual ethnic group variables were added separately. Although no covariates in the model relate to country (level 3) it was retained in the model to allow for analysis of residual variance at this level. We constructed 4 models; the first model was a null model without any variables, the second contained only individual-level variables, and the third additionally included the contextual level 2 variable of ethnic FGC percentage.

The logit multilevel model uses binomial distribution assumptions with second order linearisation and a penalised quasilikelihood (PQL) estimation type (Rasbash et al., 2012a). Continuous individual level variables (age) are centred around their grand mean, to ensure that higher level associations are adjusted for individual level characteristics. The model is expressed as;

$$\text{Logit } \pi_{ijk} = X'_{ijk}\beta + \upsilon_{jk} + v_{jk} \qquad (1)$$

where π_{ijk} is the probability of having a cut daughter for an individual mother i, in the jth ethnic group in the kth country; X'_{ijk} are the covariates defined at levels 1 – 3 and υ_{jk} and v_{jk} are the residuals at the ethnic and country level respectively. We constructed 4 models; the first model was a null model without any variables, the second contained only individual-level variables, the third additionally included the contextual level 2 variable of ethnic FGC percentage, and the fourth additionally included a cross-level interaction between mother's FGC status and ethnic FGC percentage.

To calculate or partition the variance attributable to different levels within the model, two different measures were calculated as described by Goldstein, and Snijders and Bosker (Snijders, 1999;Goldstein, 2010). The intra-class correlation coefficient (ICC), expressed as a percentage, gives a measure of the variance in the logistic outcome attributable to different levels in the model. The median odds ratio (MOR) translates the level 2 or 3 variance into the odds ratio scale, and gives an

indication of the increased risk of the outcome, in this case the extent to which the individual probability of having a cut daughter is determined by ethnic group or country. Both help to interpret the importance of the ethnic group (level 2) and country (level 3) on the individual woman's propensity to have a cut daughter. The MOR and ICC are calculated as follows;

$$MOR = \exp(0.95\sqrt{U_{jk}}) \quad (2)$$

$$ICC = U_{jk}/(U_{jk}+3.29) \quad (3)$$

Predicted probabilities were calculated according the SPSS and MLwiN defaults which set other continuous parameters to their mean average value, and other categorical parameters to the proportion of cases in each category.

6.5.4 Prediction 2: Fitness benefits associated with frequency-dependent FGC behaviour

Here we test the prediction that there are fitness benefits associated with frequency-dependent FGC behaviour. Few women in the DHS have completed lifetime fertility, so as a proxy for fitness we used an age-specific measure; the total number of offspring born and still alive when the mother was 40, excluding pregnancies. Age 40 gives an adequate sample size and is sufficiently close to the age of completed fertility, and birth rates after the age of 40 years are not significantly different between women with or without FGC (analysis not presented here). Any respondents with offspring whose date of death was flagged as unreliable were excluded. All individuals who met these criteria were included, giving 10,067 women aged 40-49 years who were from a major ethnic group and who had given their FGC status. The surviving offspring data was normally distributed, and assumptions justifying the use of linear regression were met.

We first analysed the relationship between FGC frequency and fitness in each country separately using aggregate data. We calculated the percentage difference in the average number of surviving offspring for women with and without FGC in each ethnic group, and performed Pearson's bivariate correlation (two-tailed) to examine the association between this measure and ethnic FGC frequency. Ethnic groups with fewer than five individuals with or without FGC were omitted from the analysis as the variance of their means is excessive.

For the main analysis we performed a three level regression model (level 1: individual n10,067, level 2: ethnic group: n47, level 3: country n5) controlling for individual-level variables; mother's FGC status, education (no education/some education), religion (Muslim/non-Muslim), and wealth (quintiles). Ethnic FGC frequency was added as a level 2 contextual variable and we also included a cross-level interaction between FGC status and ethnic FGC frequency which allows for the effect of

FGC status to vary depending on FGC prevalence in the ethnic group. Although no covariates in the model relate to country (level 3) it is retained in the model to allow for analysis of residual variance at this level. The model is expressed as;

$$y_{ijk} = \beta_0 + \beta' x_{ijk} + v_{0k} + u_{0jk} + e_{ijk} \quad (4)$$

where y_{ijk} is the response, β_0 is the intercept, $\beta' x_{ijk}$ are the predictor variables at all levels, v_{0k} is the random effect at country level, u_{0jk} is the random effect at the ethnic group level for ethnic group *j* in country *k*, and e_{ijk} is the random effect at the individual woman level.

MLwiN version 2.35 was used for multilevel modelling, and SPSS v23 was used in other analyses.

CHAPTER 7 CAN EVOLUTIONARY SEXUAL CONFLICT HELP TO EXPLAIN PATTERNS OF MALE-TO-FEMALE IPV?

Abstract

The WHO estimates that globally almost a third of women experience intimate partner violence (IPV) over their lifetime. Due to the detrimental impact on women's health and well-being, the motivations behind male-to-female IPV are of interest to policy-makers, social scientists, and increasingly to evolutionary anthropologists.

Evolutionary sexual conflict theory proposes that conflict arises between the sexes due to differences in evolutionary interests. In humans these evolutionary conflicts may cause actual conflict between couples, potentially resulting in physical IPV (IPPV) or sexual IPV (IPSV). Two hypotheses based on this theory have been proposed; 1) IPV is perpetrated by men in response to their wives' actual or perceived risk of extra-pair sex; and 2) IPV is perpetrated as a result of reproductive conflicts where men pursue a higher fitness optima than their wives, either within the marriage (reproductive coercion) or with alternative partners outside the marriage (paternal disinvestment). To date, however, these hypotheses remain largely untested using empirical data.

Here, Demographic and Health Survey data from couples in 12 sub-Saharan African countries (n 25,577) is used to test these evolutionary hypotheses using multilevel logistic regression analysis. The results differ by IPV type. Indicators of paternity concern increase the risk of both IPPV and IPSV. Indicators of paternal disinvestment (husband is polygamous, has had extramarital sex, and has more living children than his wife) increase the odds of IPPV only. Reproductive coercion is not shown to be associated with either type of IPV. The areas of conflict identified which are associated with IPV perpetration correspond with risk factors identified by proximate level explanations, but an evolutionary interpretation explains why these factors may motivate IPV in certain contexts. Together these results enhance our understanding of the different motivations behind IPPV and IPSV, and indicate how an evolutionary approach can increase our understanding of male-to-female IPV.

7.1 INTRODUCTION

Intimate partner violence (IPV) is defined as physical, sexual, and emotional abuse as well as controlling behaviours towards an intimate partner (WHO, 2012a). The most recent World Health Organisation (WHO) report estimates that globally around 30% of women experience IPV during their lifetime (García-Moreno et al., 2013). Prevalence varies substantially between countries, for example, lifetime and past year IPV experience is shown to range between 15-71% and 4-54% respectively in a recent WHO multi-country study (Garcia-Moreno et al., 2006). IPV is recognised as a fundamental human rights violation (UN General Assembly, 1993). The significant global impact of IPV on women's health is well-documented. Research shows that in addition to physical injury, IPV can result in a wide range of mental, reproductive and sexual health problems including higher risk of HIV and other sexually transmitted infections, and as well as impacting on the health and well-being of children in the family (WHO et al., 2013;Dunkle et al., 2006;Silverman et al., 2007;Dude, 2011;Rico et al., 2011). IPV also has significant economic costs in terms of decreased productivity and loss of earnings (Duvvury et al., 2013). Consequently, male-to-female IPV is a priority for policy makers, and is encompassed in the UN's Sustainable Development Goal 5.2 which targets the elimination of all forms of violence against women and girls by 2030 (UN, 2016). Hereafter, the term IPV refers to male-to-female IPV, and physical IPV (IPPV) and sexual IPV (IPSV) are the specific behaviours of interest in this study.

As a result of intense research activity into IPV in recent years, there is increasing consensus concerning the risk factors associated with IPV perpetration. Typically studies have used women's reported experiences of victimisation to identify IPV risk factors and prevalence, rather than men's reports of perpetration (García-Moreno et al., 2005;Devries et al., 2013b;Jewkes, 2002;WHO/LSHTM, 2010). Recently, more studies have collected IPV perpetration data from men, with a view to understanding men's motivations and designing interventions targeted at men (Jewkes et al., 2015). Twenty-seven studies from low- and middle-income countries (LMIC) which collected men's self-reported IPV perpetration were identified to assess risk factors most commonly associated with male perpetration (Appendix Table 7.1). Male factors commonly tested and found to be associated with IPV perpetration include poverty, adverse childhood experiences, drug and alcohol use, having multiple sexual partners, poor mental health, involvement in violence with other men, and non-equitable gender attitudes. Additionally, the WHO reports that younger age, lower levels of education, personality disorders, and a history of abusing partners also increase the likelihood of men perpetrating IPV (WHO, 2012a).

Although a common recognition of risk factors is developing, the theoretical understanding about why these risk factors increase IPV perpetration, and why there is such variation in IPV prevalence between communities is still unclear.

7.2 THEORETICAL FRAMEWORKS APPLIED TO IPV PERPETRATION

Theory from different disciplines has been applied to provide an explanation for why men might perpetrate IPV. It is useful to differentiate these explanations according to the level of explanation they address, using Tinbergen's framework (Tinbergen, 1963). This framework recognises that behaviours can be explained at four different levels which relate to the immediate cause of the behaviour (proximate cause), the adaptive value of the behaviour (ultimate cause), the developmental learning of the behaviour (ontogenetic cause), and the evolutionary history of the behaviour (phylogenetic cause). Explanations at these different levels of causation are non-competing. Ultimate level explanations are the primary interest of this study.

7.2.1 Proximate level explanations for IPV

Several proximate level theories have been put forward to explain why men perpetrate IPV. These include; feminist theory which attributes IPV to a male desire to control and dominate women (Yllö and Bograd, 1988;Russo and Pirlott, 2006;García-Moreno and Organization, 2005;Dobash and Dobash, 1979;Smith, 1990); family violence theory which does not consider IPV to be a gendered behaviour and anticipates sex-symmetry in IPV perpetration (Straus and Gelles, 1986;Dutton and Nicholls, 2005); pathological explanations for IPV behaviour (Quinsey, 2010); and relative resource theory, which predicts that women with more resources than their husbands may be at greater risk of IPV (Atkinson et al., 2005;Allen et al., 1975). Social learning theory, which has also been proposed an explanation for IPV, may be better classified as an ontogenetic rather than proximate level explanation as it relates to developmental learning (O'Leary, 1988). This proposes that witnessing or experiencing IPV in childhood predicts IPV perpetration in adulthood.

As the complexity of IPV became clear, single factor theories have been replaced by multifactor theories which incorporate elements of many of the theories above. The current prevailing view, adopted by the WHO, is that IPV is best understood using an ecological framework (WHO/LSHTM, 2010). This framework describes how the interaction of factors at four overlapping levels contribute towards IPV occurrence (Heise, 1998;Chalk and King, 1998;Krug et al., 2002). These levels are: 1) individual attitudes and experiences that increase the likelihood of men perpetrating violence and of women being victimised; 2) interactions or conflict between couples at the relationship level; 3) social or community norms concerning the acceptance of IPV and strength of sanctions against

perpetrators; and 4) macrosocial factors, or national frameworks, such as women's economic and legal rights (Heise, 2011). The ecological framework and the other proximate theories discussed above do not distinguish between IPV types. There is little discussion in any of the above theoretical literature acknowledging the different types of IPV or addressing whether different motivations may explain the occurrence of physical and sexual IPV.

7.2.2 Ultimate level explanations for IPV

Ultimate level explanations consider the adaptive value of a behaviour and its impact on evolutionary fitness (Tinbergen, 1963). Evolutionary fitness is defined as an individual's contribution to the gene pool of future generations, often measured by actual, or proxies for, an individual's reproductive success (Nettle et al., 2013). Behaviours motivated by ultimate causes are not predicted to promote health and well-being, but rather to promote evolutionary fitness (Hill, 1993). Context is of fundamental importance to understanding the fitness consequences of performing a behaviour; a behaviour may enhance fitness in one context, but limit fitness in another. It is anticipated that individuals will flexibly adopt fitness enhancing behaviours depending on their context, assessing the evolutionary costs and benefits (Krebs and Davies, 2009;Borgerhoff Mulder, 1991;Nettle et al., 2013).

Accordingly, evolutionary explanations for IPV propose that men will perpetrate IPV in contexts where they gain a fitness benefit from doing so. This ultimate level explanation is not an alternative to the proximate or ontogenetic explanations described in Section 7.2.1. It is anticipated that there may be overlap between the risk factors which trigger an ultimate or proximate level response resulting in IPV perpetration (Smuts, 1995). However, an evolutionary approach goes beyond the theory that men perpetrate IPV in order to dominate and control their partners, and seeks to explain why, in certain contexts, they might be driven to do so (Goetz and Shackelford, 2009;Goetz et al., 2008;Figueredo et al., 2012).

Broad support that evolutionary drivers and concern about reproductive outcomes may be motivating factors for IPV comes from the typical demographics of perpetrators and victims. Firstly, men more commonly perpetrate violence towards their intimate partners (with whom they will often have shared reproductive interests) than toward an acquaintance or stranger (Krug et al., 2002). The global lifetime prevalence of non-partner sexual violence is 7% (World Health Organisation, 2013) compared to estimated 10-50% IPSV prevalence, varying by country (Garcia-Moreno et al., 2012). Secondly, younger women are at greater risk of IPV when their reproductive value and expected future fertility is highest (Peters et al., 2002;Capaldi et al., 2012;Abramsky et al., 2011).

However, an opposing perspective queries the adaptive value of men perpetrating IPV given the potential costs involved. Humans are characterised by long-term pair bonding in which men and women often have mutual interest in their shared offspring, and the prevalence and endurance of pair bonding suggests that it is a successful strategy for both men and women (Marlowe, 2000;Chapais, 2013;Quinlan, 2008;Trivers, 1972). For men, the potential benefits are access to mating which may be less costly than seeking alternative new mates, and the ability to invest in and protect their offspring (Quinlan, 2008). The costs of jeopardising or defecting from a pair bond may therefore be substantial.

Other costs are also associated with IPV perpetration. Experiencing IPV can affect women's fertility, and therefore the husband's reproductive success, for example through pregnancy loss, prematurity and infants of low birth weight (Valladares et al., 2002;Coker, 2007;Hill et al., 2016). IPV has also been demonstrated to have a detrimental impact on the health and well-being of children in the relationship which could also reduce the perpetrator's fitness. Perpetrators also may risk retaliation from their wife or their wife's kin as well as social sanction by the community (Jones and Ferguson, 2009;Clark et al., 2010).

In view of the potential costs related to IPV perpetration, and the benefits men gain from long-term pair bonding and the closely aligned fitness interests between husbands and wives, IPV appears counterintuitive. However, IPV is also a widespread human behaviour, perpetrated at high levels in many societies (WHO, 2012c). In this study the circumstances that might motivate men to perpetrate IPV are examined, using a sexual conflict framework.

7.3 SEXUAL CONFLICT THEORY

The theory of evolution by sexual selection proposes that differential reproductive success is gained through mating behaviour (Andersson and Iwasa, 1996;Krebs and Davies, 2009). Males and females are reliant on each other for successful reproduction, however fundamental biological differences mean they pursue different mating strategies (Bateman, 1948;Parker, 1979). There are two variants of sexual selection; sexual competition for mating opportunities and sexual conflict between the sexes, which is the theory relevant to this study.

Sexual conflict theory proposes that conflict arises due to differences in evolutionary interests between the sexes, particularly when the optimal value of a trait differs for each sex (Parker, 2006). In species in which females invest most parental care males have a higher potential reproductive rate , so male strategies will be aimed at gaining multiple matings in order to achieve their higher reproductive potential (Bateman, 1948). Female strategies will be aimed at securing paternal

investment in order to increase offspring survival, although females may also seek multiple matings to increase the chance of mating with higher quality males as well as ensuring fertilisation (Dawkins, 1976;Parker, 1979). This conflict of evolutionary interests is proposed to result in the co-evolution of strategies and counter strategies by males and females trying to achieve their own reproductive goals (Trivers, 1972).

Applying this theory to human behaviour, theorists from different areas of evolutionary science have identified three areas of conflict that might cause men to perpetrate physical or sexual IPV, which are brought together and tested here. The theory of sexual conflict has been primarily developed in animal studies, and the applicability of these principles to human behaviour, in particular the proposed differing fitness optima for men and women has been challenged, this is discussed further below in Section 7.3.2 (Brown et al., 2009;Moya et al., 2016).

7.3.1 Paternity concern

In a sexual conflict framework extra-pair sex may be a strategy used by females to ensure fertilisation and increase the variation in genetic quality of their mates, while males have evolved counter-strategies to correct, prevent or anticipate female extra-pair sex to reduce their non-paternity rate (Barbaro, 2017;Stumpf and Boesch, 2005). In humans counter-strategies are thought to include both morphological adaptations (e.g. sperm competition (Pham and Shackelford, 2014)) as well as a range of behavioural adaptations such as mate-guarding, controlling behaviours, and IPV (Hartung, 1985;Geary, 2005;Buss, 1989).

The paternity concern theory for IPV has been most extensively developed by evolutionary psychologists who argue that male sexual jealousy is a universal cognitive function selected to address the issue of female infidelity and paternity uncertainty (Daly et al., 1982;Goetz et al., 2008). Evolutionary psychologists consider that all types of IPV are motivated by constraining women's sexual activity (Figueredo et al., 2012). However, men may use less severe forms of sexual coercion (i.e. IPPV rather than IPSV) to reduce the costs of IPV but still decrease the likelihood of their partner engaging in extra-pair sex (Goetz and Shackelford, 2009;Camilleri and Quinsey, 2012).

The results of a number of studies give support to the paternity concern theory. It has been found that men who perpetrated IPSV were more likely to have accused their partner of sexual infidelity (Finkelhor and Yllö, 1987;Russell, 1982;Starratt et al., 2008;Goetz and Shackelford, 2009;Camilleri and Quinsey, 2009), or to report sexual jealousy (Frieze, 1983), or to report a greater perceived likelihood of their partner having extra-pair sex (McKibbin et al., 2011). Studies have found that accusations of female sexual infidelity predict IPPV (Kaighobadi et al., 2008) and men who perceive a

risk of partner infidelity were found to be more likely to perpetrate IPPV than IPSV (Kaighobadi et al., 2009) supporting the suggestion that IPPV may function as sexual coercion. Likewise, some non-evolutionary studies conducted in LMIC identified a husband's suspicion of his wife's infidelity as a key risk factor for violence (El-Bassel et al., 2001;Townsend et al., 2011;Peedicayil et al., 2004), and have found that husbands who perpetrate IPSV are more sexually jealous (Frieze, 1983;Gage and Hutchinson, 2006). IPV may also function to terminate a pregnancy where the husband is uncertain of the paternity (Buss and Duntley, 2011).

While this literature provides some evidence that IPPV and IPSV may be motivated by paternity concern, it is not conclusive. The global variation in IPV prevalence, as well as studies which have shown cross-cultural differences in sexual jealousy query whether sexual jealousy is a gendered behaviour (Buunk and Hupka, 1987;Schützwohl and Koch, 2004). Secondly, the IPV literature has shown that variables which are indicative of a poor-quality environment influence IPV rates (e.g. poverty, education, childhood exposure to violence, and alcohol use), however these are not controlled for in the evolutionary psychology studies cited above (Jewkes et al., 2013). To date no evolutionary anthropologists have examined the association between paternity certainty and IPV using cross-cultural studies and multivariate analysis, controlling for the variation in individual and contextual factors.

7.3.2 Reproductive conflict

The other source of evolutionary conflict suggested by the sexual conflict framework relates to the proposal that males and females have differing fitness optima, which has been demonstrated in the animal literature (Bateman, 1948;Clutton-Brock, 2007;Parker, 1979). In humans the evidence is circumstantial. Surveys documenting men's preference for larger family sizes than women is interpreted as evidence of differing fertility optima in humans, and that men and women's fitness goals are not necessarily aligned (Mason and Smith, 2000;Westoff and Bankole, 2002;Mason and Taj, 1987;Borgerhoff Mulder and Rauch, 2009). Likewise, evidence that women tend to have higher fertility when living near their husband's family than their own family is also interpreted as evidence that men, and the men's family are more pro-natal than women (Sear et al., 2002). However, the notion that men have a higher fitness optima than women has recently been contested by evolutionary anthropologists who emphasise the plasticity of human behaviour and reject the idea of rigid sex roles (Brown et al., 2009;Moya et al., 2016). Instead men and women's fertility optima are predicted to vary by context and will be influenced by contextual factors such as sex ratios, kinship systems, religion, gender roles and paternal care expectations (Borgerhoff Mulder and Rauch, 2009).

Therefore, the proposal that men have a higher fitness optima than women is viewed with caution, however it has been put forward as an explanation for IPV in two different circumstances. Both circumstances arising where men try to achieve higher fitness than their wives' desires; either men may try to achieve this within their marriage potentially through sexual or reproductive coercion, or men may divert reproductive activity to an alternative partner outside the marriage, which causes conflict potentially escalating to IPV within the marriage. The theory and evidence that either strategy may be associated with IPV are discussed below.

7.3.2.1 Reproductive coercion within marriage

The perceived sexual rights of men over their wives has been widespread historically and geographically, and marital rape is still not criminalised in many countries (Turquet, 2011;World Bank, 2018). Reproductive coercion has been associated with all types of IPV and it is suggested that men use IPV to control their wives' fertility, potentially to achieve their own fitness goals (Miller et al., 2010;Falb et al., 2014;Clark et al., 2014).

The prediction that IPV is motivated by men's higher fitness goals has not been directly tested in the evolutionary anthropology literature, and relevant findings come from a range of sources. Studies have found that men who perpetrated IPPV and IPSV in the past year had significantly higher odds of fathering a pregnancy (Christofides et al., 2014), that men reporting IPV perpetration during the past year were significantly more likely to report having fathered three or more children after controlling for confounding variables (Raj et al., 2006) and that men who perpetrated IPPV gained more frequent sexual access to their partner (Barbaro and Shackelford, 2016). Research on the association between IPV and (men's opposition to) women's contraceptive use is also relevant. A pertinent study found that men with higher fertility preferences than their wife used IPV to oppose their wife's contraceptive use (Forrest et al., 2018). IPV has also been associated with unwanted or unintended pregnancy by women (Pallitto et al., 2005;Cripe et al., 2008;Raj et al., 2005;Pallitto and O'Campo, 2004). However, even if men do have a higher fitness optima, it is unclear why men would solve the problems of differing fitness goals using IPV and thereby expose themselves to the range of associated costs, rather than using non-aggressive or less costly tactics.

7.3.2.2 Paternal disinvestment

An alternative male strategy to achieve a higher fitness optima than their partner is to divert their reproductive investment to an alternative relationship, for example through extra-pair sex, polygamy, or changing relationships (Geary, 2006). The term 'paternal disinvestment' has been used to describe men diverting resources away from the pair bond for their own fitness gains (Stieglitz et

al., 2011;Stieglitz et al., 2012). Paternal disinvestment may impact the wife's fitness by reducing her reproductive rate and/or negatively affecting her offspring's health or survival. A wife's objection to her husband's disinvestment could result in IPV, primarily physical rather than sexual (Stieglitz et al., 2011;Stieglitz et al., 2012). Paternal disinvestment may be more likely to result in conflict where women are economically reliant on their husbands and accordingly, women's access to resources is predicted to influence IPV prevalence (Borgerhoff Mulder and Rauch, 2009;Levinson, 1989).

Paternal disinvestment theory was developed and tested in a study of Tsimane forager-horticulturalists, which found that husbands' infidelity was the most frequent source of marital conflict, and that 60% of IPPV events occurred during arguments over men's diversion of household resources (classified as absenteeism from village due to wage labour, expenditure on alcohol, and husband's infidelity) compared to 20% of IPPV events due to arguments over husband's jealousy (Stieglitz et al., 2012). Studies from non-evolutionary literature lend support to the paternal disinvestment theory. Access to resources and economic stress is recognised as common risk factor for IPV (WHO, 2012a), and conflict over male infidelity has been shown to be a risk factor for IPV (Abrahams et al., 2006;Akhter and Wilson, 2016;Djikanovic et al., 2010). Qualitative studies also describe similar stressors leading to IPV, for example studies in Ghana and Peru found that financial disagreements were a trigger for IPV particularly when wives perceived that their husbands were spending money on girlfriends, not honouring their marital financial responsibilities, being unfaithful or spending too much money (Fuller, 2001;Sedziafa et al., 2018).

Predictions based on these two alternative reproductive conflict hypotheses (reproductive coercion and paternal disinvestment) may differ depending on variation in the availability of reproductive alternatives (Borgerhoff Mulder and Rauch, 2009). If divorce and extra-pair sex are common and men have the opportunity for extra-marital relationships, conflict based on paternal disinvestment may be more likely. If there are no alternative reproductive options available to men, conflict based on differing fertility optima within a marriage may be more likely. Likewise the risk of IPV in polygamous marriages is predicted to be lower according to reproductive coercion theory as theoretically both husband and wives could both achieve their optimal fitness, whereas paternal disinvestment theory predicts a higher risk of IPV in polygamous marriages due to a wife's objection to her husband's investment in a co-wife's household or offspring rather than her own. High risk of IPV in polygamous marriages has been found in a number of studies e.g. in Kenya (Makayoto et al., 2013;Kimuna and Djamba, 2008), in Pakistan (Rozina et al., 2008), in Tanzania (McCloskey et al., 2005), and Mali (Salihu et al., 2012) although not in a different study in Mali (Hayes and van Baak, 2017).

7.4 STUDY AIMS AND PREDICTIONS

The aim of this study is to test for an ultimate level explanation for IPV perpetration. Two evolutionary motivations for IPV based on the theory of sexual conflict are tested, paternity concern and reproductive conflict, examining their association with IPPV and IPSV separately.

IPPV and IPSV are often grouped together in analysis. However, there are several differences between IPPV and IPSV which suggest they merit separate investigation. There is no standardised list of acts that constitute IPPV and IPSV. IPPV captured in surveys varies in severity and potential injury, typically including slapping, hitting, pushing, punching and kicking, and IPSV captured in surveys is usually forced or non-consensual sexual intercourse (Logan et al., 2015). Therefore, the impact on health and well-being resulting from IPPV and IPSV may be quite distinct. Grouping together men who have perpetrated marital rape with those who have slapped their wives may overlook fundamental differences between their motivations. Another distinction is that IPSV can result in conception, which is relevant from an evolutionary perspective. The sexual nature of IPSV also distinguishes it from IPPV in which the violence is more generic.

The relationship between IPPV and IPSV is not well understood (Krebs et al., 2011). Many studies have found that IPPV and IPSV do co-occur (García-Moreno et al., 2005;Abrahams et al., 2004a). However, other studies have documented a higher prevalence of IPSV than IPPV which suggests that IPPV is not necessarily a precursor to IPSV e.g. in Cambodia and Indonesia (Fulu et al., 2013), Ethiopia, Bangladesh and Thailand (Garcia-Moreno et al., 2006), Indonesia (Hayati et al., 2011), Thailand (Ellsberg et al., 2008), India (Martin et al., 2002;Koenig et al., 2006) , Malawi (VanderEnde et al., 2016), and Ghana (Chirwa et al., 2018).

It is also unclear whether perpetrator motivations for IPPV and IPSV differ. Out of the 27 studies that have addressed male IPV perpetration, ten analysed IPSV and IPPV data separately to identify different risk factors and motivations (Appendix Table 7.1). Together the findings of these studies suggest that fewer, rather than different, variables are significantly associated with IPSV compared with IPPV. IPPV is often associated with men's poverty, lower education, gang violence, substance abuse, community norms, depression, older age. However, in the same populations these variables are not associated with IPSV (Abrahams et al., 2004;Abrahams et al., 2006;Koenig et al., 2006;Sambisa et al., 2010;Fulu et al., 2013). Further differences are shown as multiple sexual partners have been found to be associated with IPSV but not IPPV (Townsend et al., 2011;Fulu et al., 2013). The fewer significant associations with IPSV may reflect its lower prevalence, which reduces statistical power in analysis. Other studies have found that IPSV perpetration has more risk factors in common with non-partner sexual violence than with IPPV, and researchers propose that IPSV may

be related to cultural or religious gender norms that confer sexual control by men over women (Fulu et al., 2013;Jewkes et al., 2013). An alternative interpretation it that IPSV is a pathological behaviour rather than one that can be predicted by any common risks (Quinsey, 2010;Miele and Camilleri, 2016;Ali and Naylor, 2013b).

Based on the theory discussed above two predictions are tested which examine the relationship between evolutionary sexual conflict and IPV;

Prediction 1: Men exposed to indicators of paternity concern will have higher odds of perpetrating both IPPV and IPSV. The association between IPV and individual-level proxies and community-level proxies for paternity concern are tested.

Prediction 2. Men whose reproductive interests' conflict with their wives' will have higher odds of perpetrating IPV. It is predicted that IPPV will be more strongly associated with variables indicative of paternal disinvestment, and IPSV will be more strongly associated with variables indicative of reproductive coercion, where men's motivation is hypothesised to be reproductive.

7.5 METHODS AND DATA

7.5.1 Data and Sample

Demographic Health Surveys (DHS) datasets from sub-Saharan African countries were used to address these hypotheses. DHS are nationally representative surveys conducted by the United States Agency for International Development and the host government. The DHS surveys are standardised across all countries, and data is collected from around 3,000 men and 10,000 women from each country every five years on a range of subjects including socioeconomic profile, reproductive and maternal health, marriage and sexual activity. An optional IPV module was used by 18 of the most recent country surveys in sub-Saharan Africa, which is conducted on one man and one woman per household.

The DHS collects data from women about their IPV experiences, and not IPV perpetration data from men. In order to identify which men had perpetrated IPV, husbands and wives were matched from the male and female datasets. Evidence from other studies showing that female and male reports of IPV are often aligned supports this approach (Halim et al., 2018;Jewkes et al., 2017;Hoffman et al., 1994;Barker et al., 2015). In the DHS cohabiting couples are considered married whether or not a marriage ceremony has taken place. The terms wife and husband are used in either case.

Datasets from six of the 18 countries identified could not be used as husbands and wives could not be matched due to the way the IPV module was sampled. Data from the remaining countries was

selected as follows; men and women who are currently married were included, duplicate men from polygamous marriages were excluded (polygamous men are only included once in a couple with their first wife), couples married less than 12 months were excluded as the IPV outcome occurred in the 12 months preceding the survey, respondents whose ethnic group was unknown were excluded, and ethnic groups with fewer than 50 members were excluded. This provided a final sample of 25,577 couples from 103 identifiable ethnic groups, in 12 countries (Burkina Faso, Chad, Ethiopia, Gambia, Ghana, Ivory Coast, Kenya, Malawi, Mali, Nigeria, Togo and Zambia).

A cross-cultural approach reveals diversity and variation in behaviour, however, there is a possibility that ethnic groups do not act independently of one another due to cultural diffusion between societies as well as common ancestry between societies, known as Galton's problem (Naroll, 1965). The importance placed on this question varies with researchers, as well as the different research methods which can be used to mitigate this problem (Ember, 1971;Mace and Holden, 1999). Phylogenetic methods are one option, where ethnic groups with common ancestry are identified and grouped (Grollemund et al., 2015). As preliminary analysis for this study the ethnic groups within the 12 identified country's datasets were matched to the Bantu language groups using the Guthrie classification (see Appendix Table 7.2) (Maho, 2003;Guthrie, 2017). Bantu Guthrie zones use historical, linguistic and cultural data to group ethnicities with shared ancestry. This enabled IPV behaviour to be analysed by Guthrie zones, which are distinct phylogenetically. However, the preliminary analysis revealed firstly that only three of the twelve countries have ethnic groups within the Guthrie zones (Kenya, Malawi and Zambia), 29 of which (n 15,592 women) could be identified to 7 specific Guthrie zones. Secondly the analysis showed statistically significant difference in IPV prevalence between ethnic groups within each of the Guthrie zones, indicating that variation in IPV incidence between ethnic groups is not related to phylogenetic grouping or common ancestry. Therefore, rather than limiting the DHS sample to ethnic groups which could be matched to Guthrie zones, the total DHS sample was used and correlation between behaviour by ethnic group was controlled for using multilevel analysis (Goldstein, 2010).

7.5.2 Variables used in statistical analysis

Women's self-reported experience of IPPV and IPSV in the last 12 months are the outcome variables used to test both hypotheses. IPV experience was restricted to the last 12 months, rather than lifetime experience, in order to match men's circumstances with their recent IPV perpetration as far as possible. The DHS asks women whether they experienced any physical IPV (being pushed, shaken, slapped, punched, kicked, dragged, beaten up, choked or attacked with a weapon) and sexual IPV (being forced, physically or in any other way, to have sexual intercourse, or perform sexual acts).

Women who reported that they had experienced one or more of these behaviours, either sometimes or often, were coded as having experienced IPV. The control variables used to test both hypotheses have been shown to be associated with IPV in other studies (see Appendix Table 7.1). These are; household wealth (quintiles as coded by the DHS), household location (urban or rural), husband's education (none, primary, secondary or higher), husband's religion (Muslim, Christian, other/none), husband's alcohol use (yes or no), husband's age, wife's age, and childhood exposure to physical violence. To control for the husband's gender attitudes the husband's engagement in transactional sex (yes/no) and the number of IPV justifications agreed with by the husband (0-5), were used (Chirwa et al., 2018;Dunkle et al., 2006). Men are asked whether IPV is justified if his wife goes out without telling him, neglects the children, argues with him, refuses to have sex with him, or burns the food. Childhood exposure to physical violence was calculated using women's responses to the question of whether their father beat their mother (as this was not collected for men), at the ethnic group level. Additionally, in the paternity concern models the number of marriages were controlled for as this will be confounded with the respondent's sexual history. Individuals are coded as having had one or more than one marriage. Experience/perpetration of IPPV was controlled for in the models examining IPSV, and IPSV experience/perpetration was controlled for used in the models examining IPPV.

Differences in age, educational level and employment status between the husband and wife have been shown in some studies to be associated with IPV (Yount et al., 2016;Yount et al., 2018;Teitelman et al., 2017). However, the direction of the association is not uniform and in initial analysis these variables were shown not to have a significant association with the IPPV or IPSV so these control variables were excluded.

7.5.2.1 Experimental variables:

Hypothesis 1: Men exposed to indicators of paternity concern will have higher odds of perpetrating IPPV and IPSV

The DHS asks women three questions about their husbands' controlling behaviours which are relevant to paternity concern; whether her husband is jealous when she talks to other men; whether he accuses her of being unfaithful; and whether he insists on knowing where she is at all times. The answers reveal the husband's general behaviour, rather than being time-bound.

The other proxy indicators used to test for paternity concern relate to the husband and wife's sexual activity, and the sexual activity of men and women in their ethnic group (Table 7.1). The use of proxy indicators for reproductive success is an established approach in human behavioural ecology studies

where actual reproductive success cannot be measured (Nettle et al., 2013;Mattison and Sear, 2016). The use of group-level indicators in the model is supported by other studies which have shown using multilevel modelling that certain community characteristics, although not directly related to IPV, can also affect the risk of IPV occurring (VanderEnde et al., 2012). Indicators of ethnic group level sexual activity have also been used to test paternity concern (Howard and Gibson, 2019).

Table 7.1 Proxy indicators of paternity concern

	Proxy	Indicator	Assumptions
INDIVIDUAL	Wife's sexual activity	Sex before marriage (yes/no)	If a husband knows his wife had sex before marriage, or a greater number of sexual partners, he may assess the risk of extra-pair sex during their marriage to be higher.
		Total lifetime number of sexual partners (1, 2, 3, or 4+)	
	Husband's sexual activity	Sex before marriage (yes/no)	Men use their own sexual experiences as a measure of their wife's likelihood of extra-pair sex.
		Total lifetime number of sexual partners (1, 2, 3, or 4+)	
GROUP	Sexual activity by women in ethnic group	Prevalence of sex before marriage (%)	A husband may be aware of sexual behaviour by women his ethnic group and these may influence his assessment of risk of extra-pair sex.
		Average no. of sexual partners	
	Sexual activity by men in ethnic group	Prevalence of sex before marriage (%)	Men may be aware of men's sexual norms and use this to assess how likely it is that their wife will engage in extra-pair sex with another man in the group.
		Average no. of sexual partners	

Sex before marriage is calculated from men and women's responses to their age at first sex and age at first marriage. Total lifetime number of sexual partners is taken from survey responses, and treated as a categorical rather than scale variables as the data is highly skewed. Women were asked whether they had sex with anyone other than their partner in the 12 months preceding the survey, however only 1% of women responded affirmatively so this variable is not included in analysis. Ethnic group prevalence and averages are calculated from individual responses.

The DHS records whether others are present during the questions on sexual activity. Women for whom this was the case are excluded from the sample as preliminary analysis showed that the presence of others affected these answers. Additionally, there were some missing responses for questions concerning sexual activity. Together this reduced the sample size by 5,229 to 20,610.

Hypothesis 2: Men whose reproductive interests' conflict with their wives' will have higher odds of perpetrating IPV.

To test this hypothesis variables indicative of men having higher fitness optima than their wives are examined in relation to two theories; 1) reproductive coercion and 2) paternal disinvestment.

The experimental variables used to test reproductive coercion concern men and women's stated fertility preferences. Men and women are asked about their desire for more children with the possible responses; more within 2 years, more after 2 years, more but time unspecified, don't know, infertile/sterilised (partner or themselves), or want no more. A comparative variable was calculated from the husbands' and wives' responses; both want the same, husband wants more/sooner, wife wants more/sooner, either or both unsure.

The experimental variables used to test paternal disinvestment are indicators that the husband is investing resources outside of the wife's family unit to enhance his own fitness. These are whether the husband is polygamous, has more living children than his wife, or has had extramarital sex in the preceding 12 months. The model also includes a variable relating to women's employment status and type of earnings (cash or in kind), as marital conflict caused by paternal disinvestment may vary with how dependent the wife is on her husband for resources. Women who have cash or in-kind earnings are predicted to have a lower risk of IPV. As data exclusions relating to women's sexual activity do not apply, the sample size for this analysis is 25,577.

7.5.3 Statistical analysis

Data from all 12 countries were pooled and multilevel multivariate logistic regression models were used to examine the association between women's experience of IPPV and IPSV and the experimental variables and experimental variables relevant to each hypothesis. Multilevel models deal with hierarchically structured data and partition the sources of behavioural variance at different levels within the model. This approach is particularly appropriate for DHS datasets as ethnic group affinity has been shown to be a strong determinant of individual behaviour (Yoder and Wang, 2013a), and the multilevel model structure allows for this clustering at the ethnic group level. Three levels were used; individuals (n 25,577 or n 20,348), nested within ethnic groups (n 103), nested within countries (n 12).

A number of models were run to test each hypothesis; first each experimental variable was added separately to a model containing just the control variables; secondly an adjusted model was run which included all experimental variables shown to be significant in the control models. Finally, all variables relating to both hypotheses were tested in one model.

MLwiN v2.03 was used for multilevel modelling, and SPSS v23 was used for other statistical analysis.

7.6 RESULTS

In the 12 months preceding the DHS surveys 15.9% of men within the sample perpetrated IPPV (ranging from 7.7-24.8% by country) and 8.5% of men perpetrated IPSV (ranging from 1.3-16.7% by country), overall 4.4% of men perpetrated both. Malawi was the only country in which the prevalence of IPSV was higher than IPPV (16.7% compared to 15.7%). Among women experiencing any IPV, 55.6% who experienced IPSV also experienced IPPV, whereas 29.7% who experienced IPPV also experienced IPSV. Descriptive data for variables used in testing both hypotheses are shown in Appendix Table 7.3 and Appendix Table 7.4.

The same control variables were used in the models testing both hypotheses. The sample sizes used in each model varied due to the selection criteria (see methods Section 7.5.1 above), however, the association with most control variables was similar in both models. The results quoted here are from the paternity concern model Table 7.2.

The direction and significance of some control variables on the risk of IPPV were line with many previous studies. Men who drink alcohol had much higher odds of perpetrating IPPV (OR 2.66, CI95% 2.42-2.93, p<0.000). Women living in urban rather than rural areas were significantly more likely to experience IPPV (OR 0.84, CI95% 0.75-0.95, p<0.000). The number of IPV justifications agreed with by the husband was significantly associated with IPPV perpetration (OR 1.08, CI95% 1.05-1.11, p<0.000) and childhood exposure to IPV increased the odds of IPPV (OR 1.02, CI95% 1.01-1.03, p<0.000).

The association with some control variables on IPPV differ from previous studies. Men's education did not have a large association with IPPV perpetration, and only men with higher (but not primary or secondary) education had lower odds of perpetrating IPPV (OR 0.76, CI95% 0.60-0.96, p=0.024). Men's rather than women's age was significantly associated with IPPV, and younger men had higher odds of perpetrating IPPV (OR 0.97, CI95% 0.96-0.98, p<0.000). Religion was significantly associated with IPPV and Christian men had significantly lower odds of perpetrating IPPV than Muslim men (OR 0.80, CI95% 0.67-0.94, p=0.009). Household wealth had an unexpected association with IPPV as the wealth quintiles followed an n shape, with women in poorer or middle wealth households being significantly more likely to experience IPPV than women in poorest or richest households. Couples in which either the husband or wife has had more than one marriage had higher odds of experiencing IPPV (OR 1.22, CI95% 1.10-1.34, p<0.000 and OR 1.16, CI95% 1.02-1.32, p=0.017 respectively). As anticipated men who perpetrated IPSV were at much higher odds of perpetrating IPPV (OR 7.69, CI95% 6.85-8.64, p<0.000).

Table 7.2 Paternity concern: Results of multilevel multivariate logistic regression control models testing the association between IPPV and IPSV in the past 12 months and experimental variables relating to paternity concern hypotheses.

Results show the effect of adding each experimental variable separately to the control variables.

Country (n 12) Ethnic groups (n 103) Couples (n 20,610)

		IPPV			IPSV		
		OR	95% CI	p-value	OR	95% CI	p-value
Control variables							
Household wealth (Poorest)	Poorer	1.166	(1.025 - 1.328)	0.020 *	0.960	(0.811 - 1.136)	0.631
	Middle	1.191	(1.039 - 1.366)	0.012 *	1.015	(0.853 - 1.209)	0.865
	Richer	0.973	(0.835 - 1.134)	0.728	0.962	(0.791 - 1.170)	0.696
	Richest	0.927	(0.769 - 1.117)	0.428	0.690	(0.536 - 0.889)	0.004 **
Household residence (Urban)	Rural	0.848	(0.752 - 0.956)	0.007 **	1.002	(0.852 - 1.179)	0.984
Husband's education (None)	Primary	1.064	(0.931 - 1.216)	0.366	1.031	(0.856 - 1.243)	0.740
	Secondary	1.108	(0.955 - 1.287)	0.174	0.939	(0.761 - 1.158)	0.552
	Higher	0.760	(0.600 - 0.964)	0.024 *	0.742	(0.525 - 1.050)	0.093
Husband's religion (Muslim)	Christian	0.802	(0.679 - 0.947)	0.009 **	0.882	(0.683 - 1.141)	0.338
	Other/none	0.921	(0.737 - 1.152)	0.470	0.916	(0.650 - 1.290)	0.615
Husband drinks alcohol (No)	Yes	2.667	(2.423 - 2.936)	0.000 ***	1.498	(1.319 - 1.701)	0.000 ***
Husband's age		0.974	(0.965 - 0.984)	0.000 ***	0.999	(0.987 - 1.011)	0.876
Wife's age		1.004	(0.994 - 1.014)	0.463	0.997	(0.983 - 1.011)	0.685
No. IPV justifications husband agrees with		1.084	(1.051 - 1.119)	0.000 ***	1.052	(1.008 - 1.099)	0.021 *
Husband ever paid for sex (No)	Yes	1.073	(0.930 - 1.237)	0.339	0.840	(0.699 - 1.010)	0.177
Childhood exposure to IPV (%)		1.025	(1.015 - 1.035)	0.000 ***	1.019	(1.004 - 1.033)	0.012 *
Wife: More than one marriage (No)	Yes	1.168	(1.028 - 1.326)	0.017 *	1.223	(1.039 - 1.439)	0.016 *
Husband: More than one marriage (No)	Yes	1.220	(1.104 - 1.348)	0.000 ***	1.039	(0.909 - 1.187)	0.571
Sexual IPV (No)	Yes	7.698	(6.858 - 8.642)	0.000 ***	..	.. ..	..
Physical IPV (No)	Yes	..	.. ..	..	7.815	(6.920 - 8.824)	0.000 ***
Experimental variables (individual level)							
Husband jealous (No)	Yes	2.591	(2.358 - 2.846)	0.000 ***	2.243	(1.971 - 2.553)	0.000 ***
Husband accuses of infidelity (No)	Yes	3.357	(3.049 - 3.695)	0.000 ***	2.286	(2.025 - 2.582)	0.000 ***
Husband insists knowing where wife is (No)	Yes	1.958	(1.793 - 2.139)	0.000 ***	2.855	(2.523 - 3.230)	0.000 ***
Wife: sex before marriage (No)	Yes	1.148	(1.047 - 1.259)	0.003 **	1.067	(0.945 - 1.205)	0.291
Wife: no. sexual partners (one)	Two	1.234	(1.101 - 1.382)	0.000 ***	1.035	(0.888 - 1.205)	0.662
	Three	1.416	(1.215 - 1.650)	0.000 ***	1.713	(1.416 - 2.071)	0.000 ***
	Four or more	1.581	(1.305 - 1.916)	0.000 ***	1.675	(1.314 - 2.136)	0.000 ***
Husband: sex before marriage (No)	Yes	1.026	(0.927 - 1.136)	0.619	1.034	(0.903 - 1.183)	0.065
Husband: no. sexual partners (one)	Two	1.085	(0.935 - 1.260)	0.286	1.149	(0.941 - 1.403)	0.610
	Three	1.141	(0.974 - 1.337)	0.105	1.092	(0.880 - 1.355)	0.173
	Four or more	1.102	(0.924 - 1.314)	0.284	1.043	(0.821 - 1.325)	0.426
Experimental variables (ethnic group level)							
Women: Sex before marriage prevalence %		1.003	(0.996 - 1.009)	0.437	1.005	(0.996 - 1.015)	0.262
Women: Mean number of lifetime sexual partners		1.146	(0.929 - 1.413)	0.203	1.106	(0.815 - 1.502)	0.516
Men: Sex before marriage prevalence %		1.006	(1.000 - 1.012)	0.058	0.997	(0.988 - 1.006)	0.554
Men: Mean number of lifetime sexual partners		1.029	(0.986 - 1.075)	0.180	0.969	(0.909 - 1.034)	0.347

Notes:

Reference categories for categorical variables are shown in brackets

Table 7.3 Paternity concern: Results of fully adjusted multilevel multivariate logistic regression models testing the association between IPPV and IPSV in the past 12 months and experimental variables relating to paternity concern hypotheses.

Country (n 12) Ethnic groups (n 103) Couples (n 20,610)

		IPPV				IPSV			
		OR	95% CI		p-value	OR	95% CI		p-value
Control variables									
Household wealth (Poorest)	Poorer	1.153	(1.007	- 1.319)	0.039 *	0.953	(0.802	- 1.133)	0.588
	Middle	1.149	(0.998	- 1.323)	0.055	1.003	(0.838	- 1.201)	0.971
	Richer	0.921	(0.786	- 1.080)	0.313	0.943	(0.770	- 1.154)	0.565
	Richest	0.890	(0.733	- 1.081)	0.243	0.676	(0.522	- 0.876)	0.003 **
Household residence (Urban)	Rural	0.889	(0.784	- 1.007)	0.065	1.048	(0.887	- 1.238)	0.579
Husband's education (None)	Primary	1.013	(0.881	- 1.164)	0.849	0.968	(0.800	- 1.170)	0.729
	Secondary	1.041	(0.892	- 1.215)	0.612	0.862	(0.696	- 1.067)	0.171
	Higher	0.723	(0.563	- 0.927)	0.010 *	0.676	(0.474	- 0.963)	0.030 *
Husband's religion (Muslim)	Christian	0.798	(0.671	- 0.948)	0.010 *	0.891	(0.687	- 1.157)	0.387
	Other/none	0.938	(0.744	- 1.182)	0.590	0.919	(0.649	- 1.303)	0.637
Husband's alcohol use (No)	Yes	2.411	(2.177	- 2.670)	0.000 ***	1.385	(1.215	- 1.580)	0.000 ***
Husband's age		0.977	(0.968	- 0.987)	0.000 ***	1.002	(0.990	- 1.014)	0.789
Wife's age		1.003	(0.993	- 1.013)	0.521	0.997	(0.983	- 1.011)	0.709
No. IPV justifications husband agrees with		1.083	(1.048	- 1.120)	0.000 ***	1.052	(1.006	- 1.101)	0.024 *
Husband ever paid for sex (No)	Yes	1.022	(0.879	- 1.189)	0.780	0.775	(0.638	- 0.941)	0.010 *
Childhood exposure to IPV (%)		0.096	(0.035	- 0.262)	0.000 ***	0.058	(0.014	- 0.241)	0.016 *
Wife: More than one marriage (No)	Yes	0.990	(0.851	- 1.151)	0.896	1.043	(0.864	- 1.259)	0.661
Husband: More than one marriage (No)	Yes	1.119	(1.002	- 1.248)	0.044 *	0.936	(0.811	- 1.080)	0.367
Sexual IPV (No)	Yes	5.669	(5.020	- 6.401)	0.000 ***	..	..	..	..
Physical IPV (No)	Yes	..	..	..	..	5.789	(5.107	- 6.563)	0.000 ***
Experimental variables (individual level)									
Husband jealous		1.765	(1.587	- 1.962)	0.000 ***	1.394	(1.206	- 1.611)	0.000 ***
Husband accuses of infidelity		2.447	(2.202	- 2.721)	0.000 ***	1.597	(1.400	- 1.821)	0.000 ***
Husband insists knowing where wife is		1.292	(1.171	- 1.425)	0.000 ***	2.289	(1.999	- 2.620)	0.000 ***
Wife: sex before marriage		1.016	(0.914	- 1.130)	0.764	0.946	(0.827	- 1.084)	0.428
Wife: no. sexual partners (one)	Two	1.174	(1.033	- 1.333)	0.013 *	1.010	(0.857	- 1.191)	0.905
	Three	1.324	(1.119	- 1.568)	0.001 **	1.735	(1.412	- 2.131)	0.000 ***
	Four or more	1.373	(1.113	- 1.693)	0.003 **	1.570	(1.212	- 2.033)	0.001 **
Random Part		**B**	**S.E.**	**p-value**	**ICC**	**B**	**S.E.**	**p-value**	**ICC**
Ethnic group		0.138	0.032	0.000	3.8%	0.257	0.062	0.000	6.8%
Country		0.164	0.081	0.045	4.7%	0.255	0.133	0.039	7.2%

Notes:

Reference categories for categorical variables are shown in brackets

ICC is the Intra Class Coefficient which is a method for measuring the variance explained by each level in the model.

Table 7.4 Reproductive conflict: Results of multilevel multivariate logistic regression control models testing the association between IPPV and IPSV in the past 12 months and experimental variables relating to reproductive conflict hypotheses.

Results show the effect of adding each experimental variable separately to the control variables.

Country (n 12) Ethnic groups (n 103) Couples (n 24,577)

		IPPV			IPSV		
Control variables		OR	95% CI	p-value	OR	95% CI	p-value
Household wealth (Poorest)	Poorer	1.150	(1.025 - 1.291)	0.017 *	0.974	(0.838 - 1.133)	0.737
	Middle	1.192	(1.056 - 1.347)	0.005 **	1.036	(0.885 - 1.211)	0.665
	Richer	0.966	(0.842 - 1.108)	0.617	0.888	(0.743 - 1.061)	0.194
	Richest	0.895	(0.758 - 1.057)	0.194	0.672	(0.535 - 0.846)	0.001 **
Household residence (Urban)	Rural	0.834	(0.749 - 0.929)	0.001 **	0.972	(0.839 - 1.126)	0.705
Husband's education (None)	Primary	1.080	(0.960 - 1.215)	0.199	1.100	(0.933 - 1.296)	0.259
	Secondary	1.100	(0.962 - 1.256)	0.159	0.952	(0.790 - 1.147)	0.606
	Higher	0.748	(0.604 - 0.926)	0.008 **	0.768	(0.560 - 1.053)	0.101
Husband's religion (Muslim)	Christian	0.793	(0.682 - 0.922)	0.003 **	0.944	(0.746 - 1.194)	0.628
	Other/none	0.894	(0.732 - 1.092)	0.274	0.989	(0.727 - 1.345)	0.945
Husband drinks alcohol (No)	Yes	2.705	(2.476 - 2.954)	0.000 ***	1.537	(1.369 - 1.726)	0.000 ***
No. IPV justifications husband agrees with		1.075	(1.046 - 1.105)	0.000 ***	1.065	(1.024 - 1.108)	0.001 **
Husband's age		0.980	(0.973 - 0.988)	0.000 ***	1.000	(0.990 - 1.010)	0.937
Wife's age		1.004	(0.994 - 1.014)	0.396	0.996	(0.984 - 1.008)	0.528
Childhood exposure to IPV (%)		1.027	(1.018 - 1.036)	0.000 ***	1.013	(1.000 - 1.027)	0.052
Sexual IPV (No)	Yes	7.791	(7.023 - 8.644)	0.000 ***			
Physical IPV (No)	Yes				8.069	(7.230 - 9.005)	0.000 ***
Experimental variables: reproductive coercion							
Husband's fertility desire (Wants no more)							
Wants more within 2 yrs		1.007	(0.895 - 1.133)	0.913	0.968	(0.827 - 1.132)	0.675
Wants more after 2 yrs		0.992	(0.892 - 1.103)	0.877	0.932	(0.813 - 1.070)	0.319
Unsure/infertile		1.008	(0.863 - 1.177)	0.919	0.805	(0.649 - 0.999)	0.048 *
Wife's fertility desire (Wants no more)							
Wants more within 2 yrs		1.151	(0.990 - 1.339)	0.067	1.176	(0.965 - 1.433)	0.107
Wants more after 2 yrs		1.019	(0.885 - 1.174)	0.795	0.961	(0.799 - 1.155)	0.667
Unsure/infertile		1.213	(1.053 - 1.397)	0.007 **	0.998	(0.833 - 1.195)	0.984
Fertility desire comparison (Both want no more)							
Disagree: husband wants more/sooner		1.137	(1.030 - 1.254)	0.010 *	1.030	(0.904 - 1.175)	0.657
Disagree: wife wants more/sooner		1.101	(0.988 - 1.226)	0.081	1.218	(1.055 - 1.405)	0.007 **
Either unsure		0.965	(0.836 - 1.113)	0.617	0.868	(0.713 - 1.055)	0.153
Wife's no. living children		1.022	(0.997 - 1.049)	0.091	1.009	(0.974 - 1.045)	0.628
Husband no. living children		1.029	(1.011 - 1.048)	0.001 **	1.020	(0.996 - 1.044)	0.105
Experimental variables: paternal disinvestment							
Living children comparison (Both have the same)							
Wife has more		1.104	(0.961 - 1.269)	0.164	1.150	(0.957 - 1.383)	0.137
Husband has more		1.219	(1.116 - 1.331)	0.000 ***	1.146	(1.021 - 1.286)	0.020 *
Polygamous (No)	Yes	1.338	(1.189 - 1.505)	0.000 ***	1.060	(0.901 - 1.247)	0.483
Husband had extramarital sex last 12 m (No)	Yes	1.331	(1.176 - 1.506)	0.000 ***	1.082	(0.918 - 1.276)	0.346
Wife's economic independence (Not working)							
No earnings		0.908	(0.810 - 1.017)	0.092	1.159	(1.354 - 1.795)	0.000 ***
Paid in cash		1.029	(0.931 - 1.138)	0.567	1.662	(1.017 - 1.358)	0.028 *
Paid in cash/kind		1.083	(0.941 - 1.247)	0.262	1.166	(1.374 - 2.010)	0.000 ***

Notes:

Reference categories for categorical variables are shown in brackets

Table 7.5 Reproductive conflict: Results of fully adjusted multilevel multivariate logistic regression models testing the association between IPPV and IPSV in the past 12 months and experimental variables relating to reproductive conflict hypothesis.

Country (n 12) Ethnic groups (n 103) Couples (n 24,577)

		IPPV				IPSV			
		OR	95% CI		p-value	OR	95% CI		p-value
Control variables									
Household wealth (Poorest)	Poorer	1.142	(1.016	- 1.285)	0.026 *	0.975	(0.839	- 1.134)	0.747
	Middle	1.161	(1.026	- 1.313)	0.018 *	1.039	(0.886	- 1.217)	0.638
	Richer	0.950	(0.827	- 1.092)	0.471	0.895	(0.747	- 1.072)	0.227
	Richest	0.871	(0.736	- 1.031)	0.110	0.674	(0.535	- 0.849)	0.001 **
Household Residence (urban)	Rural	0.819	(0.734	- 0.914)	0.001 **	0.962	(0.830	- 1.114)	0.600
Husband's education (None)	Primary	1.069	(0.949	- 1.205)	0.277	1.106	(0.937	- 1.307)	0.234
	Secondary	1.090	(0.952	- 1.248)	0.208	0.962	(0.797	- 1.161)	0.686
	Higher	0.754	(0.607	- 0.935)	0.010 *	0.790	(0.575	- 1.085)	0.145
Husband's religion (Muslim)	Christian	0.817	(0.703	- 0.950)	0.009 **	0.936	(0.738	- 1.187)	0.587
	Other/none	0.899	(0.734	- 1.100)	0.296	0.961	(0.706	- 1.307)	0.797
Husband drinks alcohol (No)	Yes	2.662	(2.437	- 2.907)	0.000 ***	1.531	(1.361	- 1.722)	0.000 ***
No. IPV reasons husband agrees with		1.074	(1.042	- 1.106)	0.000 ***	1.067	(1.026	- 1.110)	0.001 **
Husband's age		0.976	(0.969	- 0.984)	0.000 ***	0.997	(0.985	- 1.009)	0.579
Wife's age		1.005	(0.995	- 1.015)	0.242	0.997	(0.985	- 1.009)	0.637
Childhood exposure to IPV %		1.026	(1.017	- 1.036)	0.000 ***	1.013	(0.999	- 1.027)	0.067
Sexual IPV (no)	Yes	7.799	(7.016	- 8.670)	0.000 ***	..	..	..	..
Physical IPV (No)	Yes	..	..	..	..	8.004	(7.172	- 8.933)	0.000 ***
Experimental variables: reproductive coercion									
Fertility desire comparison (Both want no more)									
Disagree: husband wants more/sooner		1.120	(1.015	- 1.235)	0.025 *	1.018	(0.893	- 1.161)	0.792
Disagree: wife wants more/sooner		1.076	(0.964	- 1.201)	0.195	1.212	(1.050	- 1.398)	0.008 **
Either unsure		0.965	(0.834	- 1.115)	0.628	0.868	(0.714	- 1.057)	0.156
Experimental variables: paternal disinvestment									
Living children comparison (Both have the same)									
Wife has more		1.087	(0.944	- 1.251)	0.249	1.150	(0.957	- 1.383)	0.136
Husband has more		1.127	(1.024	- 1.241)	0.015 *	1.148	(1.023	- 1.289)	0.020 *
Polygamous (No)		1.244	(1.091	- 1.418)	0.001 **	0.994	(0.833	- 1.186)	0.946
Husband had extramarital sex last 12 m (No)		1.315	(1.160	- 1.491)	0.000 ***	1.073	(0.908	- 1.267)	0.410
Wife's economic independence (Not working)									
Works but not paid		0.908	(0.810	- 1.017)	0.092	1.159	(1.354	- 1.795)	0.000 ***
Paid in cash		1.029	(0.931	- 1.138)	0.567	1.662	(1.017	- 1.358)	0.028 *
Paid in cash/kind		1.083	(0.941	- 1.247)	0.262	1.166	(1.374	- 2.010)	0.000 ***
Random Part		**B**	**SE**	**p value**	**ICC**	**B**	**SE**	**p value**	**ICC**
Ethnic Group		0.120	0.027	0.000	3.4%	0.240	0.054	0.000	6.1%
Country		0.145	0.070	0.037	4.2%	0.430	0.202	0.033	11.6%

Notes:

Reference categories for categorical variables are shown in brackets

ICC is the Intra Class Coefficient which is a method for measuring the variance explained by each level in the model.

Table 7.6 Paternity concern and reproductive conflict. Results of multilevel multivariate logistic regression analysis testing the association between IPPV and IPSV in the past 12 months and experimental variables relating to paternity concern and reproductive conflict hypotheses.

Country (n 12) Ethnic groups (n 103) Couples (n 20,610)

		IPPV			IPSV		
Control variables		OR	95% CI	p-value	OR	95% CI	p-value
Household wealth (Poorest)	Poorer	1.135	(0.992 - 1.300)	0.066	0.968	(0.814 - 1.150)	0.712
	Middle	1.117	(0.968 - 1.289)	0.131	1.024	(0.854 - 1.229)	0.797
	Richer	0.898	(0.764 - 1.054)	0.187	0.988	(0.806 - 1.211)	0.912
	Richest	0.857	(0.703 - 1.045)	0.126	0.699	(0.538 - 0.909)	0.008 **
Household residence (Urban)	Rural	0.887	(0.781 - 1.007)	0.065	1.015	(0.858 - 1.201)	0.859
Husband's education (None)	Primary	1.016	(0.884 - 1.168)	0.820	0.950	(0.786 - 1.149)	0.599
	Secondary	1.043	(0.892 - 1.220)	0.599	0.850	(0.686 - 1.055)	0.142
	Higher	0.720	(0.561 - 0.926)	0.010 *	0.678	(0.473 - 0.970)	0.034 *
Husband's religion (Muslim)	Christian	0.796	(0.669 - 0.948)	0.010 *	0.839	(0.646 - 1.092)	0.194
	Other/none	0.925	(0.733 - 1.168)	0.515	0.869	(0.612 - 1.235)	0.435
Husband drinks alcohol (No)	Yes	2.399	(2.166 - 2.656)	0.000 ***	1.394	(1.222 - 1.589)	0.000 ***
No. IPV justifications husband agrees with		1.084	(1.049 - 1.121)	0.000 ***	1.054	(1.008 - 1.103)	0.022 *
Husband ever paid for sex (No)	Yes	0.997	(0.857 - 1.159)	0.968	0.754	(0.619 - 0.917)	0.005 **
Husband's age		0.977	(0.968 - 0.987)	0.000 ***	1.003	(0.989 - 1.017)	0.698
Wife's age		1.004	(0.994 - 1.014)	0.422	0.996	(0.982 - 1.010)	0.535
Childhood exposure (% in ethnic group)		1.028	(1.018 - 1.039)	0.000 ***	1.015	(1.000 - 1.030)	0.046 *
Wife: one or more marriages (one)	More than 1	1.007	(0.864 - 1.173)	0.934	1.074	(0.884 - 1.303)	0.474
Husband: one or more marriages (one)	More than 1	1.052	(0.919 - 1.205)	0.456	0.961	(0.810 - 1.139)	0.643
Sexual IPV (no)	Yes	5.692	(5.031 - 6.440)	0.000 ***	..	.. ..	..
Physical IPV (no)	Yes	..	.. ..	..	5.906	(5.200 - 6.709)	0.000 ***
Experimental variables: paternity concern							
Husband jealous (No)	Yes	1.740	(1.565 - 1.934)	0.000 ***	1.404	(1.212 - 1.626)	0.000 ***
Husband accuses of infidelity (No)		2.462	(2.215 - 2.737)	0.000 ***	1.597	(1.398 - 1.824)	0.000 ***
Husband insists knowing where wife is (No)		1.294	(1.171 - 1.430)	0.000 ***	2.248	(1.964 - 2.573)	0.000 ***
Wife: no. sexual partners in lifetime (one)	Two	1.194	(1.061 - 1.343)	0.003 **	0.980	(0.838 - 1.147)	0.805
	Three	1.357	(1.157 - 1.590)	0.000 ***	1.701	(1.398 - 2.069)	0.000 ***
	Four or more	1.361	(1.053 - 1.759)	0.019 *	1.857	(1.362 - 2.531)	0.000 ***
Experimental variables: reproductive coercion							
Fertility desire comparison (Both want no more)							
Disagree: husband wants more/sooner		1.131	(1.009 - 1.267)	0.035 *	1.081	(0.930 - 1.257)	0.312
Disagree: wife wants more/sooner		1.062	(0.935 - 1.206)	0.356	1.228	(1.041 - 1.447)	0.014 *
Either unsure		0.924	(0.779 - 1.096)	0.367	0.872	(0.696 - 1.092)	0.234
Experimental variables: paternal divestment							
Living children comparison (Both have the same)							
Wife has more		0.951	(0.797 - 1.135)	0.574	0.943	(0.751 - 1.183)	0.613
Husband has more		1.020	(0.902 - 1.154)	0.748	1.031	(0.882 - 1.207)	0.703
Polygamous (No)		1.198	(1.013 - 1.418)	0.037 *	0.898	(0.718 - 1.122)	0.345
Husband had extramarital sex last 12 m (No)		1.217	(1.052 - 1.406)	0.008 **	1.115	(0.922 - 1.349)	0.262
Wife's economic independence (Not working)							
Works but not paid		0.901	(0.790 - 1.028)	0.119	1.554	(1.324 - 1.825)	0.000 ***
Paid in cash		1.030	(0.918 - 1.157)	0.608	1.178	(1.007 - 1.378)	0.041 *
Paid in cash/kind		1.088	(0.926 - 1.277)	0.308	1.669	(1.345 - 2.070)	0.000 ***
Random Part		**B**	**SE**	**p value**	**ICC**	**B**	**SE**	**p value**	**ICC**
Country		0.148	0.073	0.000	4%	0.323	0.162	0.000	9%
Ethnic Group		0.132	0.031	0.006	4%	0.263	0.063	0.000	7%

Notes:

Reference categories for categorical variables are shown in brackets

ICC is the Intra Class Coefficient which is a method for measuring the variance explained by each level in the model.

Fewer control variables were significantly associated with IPSV, and where they were significantly associated, the effect size was smaller than with IPPV (Table 7.2). Household location, husband's age, wife's age, husband's religion, and childhood exposure were not significantly associated with IPSV. The husband's use of alcohol increased the odds of IPSV (OR 1.49, CI95% 1.31-1.70, p<0.000), and the number of IPV justifications agreed with significantly increased the odds of men perpetrating IPSV (OR 1.05, CI95% 1.00-1.09, p=0.021). Household wealth had a different association compared to IPPV, and only women in richest households had significantly lower odds of experiencing IPSV (OR 0.69, CI95% 0.53-0.88, p=0.004). Men who had perpetrated IPPV had higher odds of perpetrating IPSV (OR 7.81, CI95% 6.92-8.82, p<0.000).

7.6.1 Hypothesis 1: Men exposed to indicators of paternity concern will have higher odds of perpetrating IPPV and IPSV

In the control and fully adjusted models (Tables 7.2 and 7.3), the results show that men who exhibit any of the three controlling behaviours related to paternity concern had significantly higher odds of perpetrating both IPPV and IPSV. In the fully adjusted model (Table 7.3) the results show that men who are jealous when their wife talks to another man, accuse their wife of unfaithfulness, and insist on knowing where their wife is at all times, had significantly higher odds of perpetrating IPPV (OR 1.76, CI95% 1.58-1.96, p<0.000, OR 2.44, CI95% 2.20-2.72, p<0.000 and OR 1.29, CI95% 1.17-1.42, p<0.000 respectively) and IPSV (OR 1.39, CI95% 1.20-1.61, p<0.000, OR 1.59, CI95% 1.40-1.82, p<0.000, OR 2.28, CI95% 1.99-2.62 p<0.000). All three behaviours had a sizeable association, but IPPV was most strongly associated with accusations of unfaithfulness, whereas IPSV was more strongly associated with insisting on knowing where his wife is at all times.

Indicators of women's individual sexual activity had a significant association with IPPV in the control model (Table 7.3); women who had sex before marriage (OR 1.58, CI95% 1.30-1.91, p<000) and women who had 2, 3 or 4+ lifetime sexual partners were at increased odds of experiencing IPPV. However, when both variables were added to the fully adjusted model (Table 7.3), only lifetime number of sexual partners remained significantly associated with IPPV. Compared to one sexual partner, the risk of IPPV increased with each extra sexual partner (two (OR 1.17, CI95% 1.03-1.33, p=0.013) three (OR 1.32, CI95% 1.11-1.56, p=0.001) four or more (OR 1.37, CI95% 1.11-1.69 p=0.003)). The woman's number of sexual partners was the only variable significantly associated with IPSV in the control and fully adjusted models, and women who had three or four or more life time sexual partners were at significantly higher risk of IPSV (OR 1.73, CI95% 1.41-2.13, p<0.000) and (OR 1.57, CI95% 1.21-2.03, p=0.001).

Indicators of men's individual sexual activity, either premarital sex or lifetime number of sexual partners, did not significantly increase the odds of IPPV or IPSV perpetration (Table 7.2) and were therefore not included in the fully adjusted model. The group level indicators of women or men's sexual activity had a small positive association with the odds of IPPV or IPSV perpetration, but the association was not significant, and these variables were not included in the fully adjusted model.

The random part of the fully adjusted model showed that a small proportion of the country level and ethnic group level variation was explained by the full models for both IPPV (3.8% and 4.7%) and IPSV (6.8% and 7.2%) which suggests that much of the variation in IPV behaviour was explained by individual rather than group factors. However, the variance remaining is significant, which suggests that further variables not included in the model explain much of the variation.

7.6.2 Hypothesis 2: Men whose reproductive interests' conflict with their wives' will have higher odds of perpetrating IPV

The variables relating to reproductive coercion relate to the husband and wife's fertility desires, while controlling for the husband and wife's number of living children. In the control model (Table 7.4), men and women's individual desires for more children were not significantly associated with IPPV or IPSV, although women's uncertainty over desires increased the risk of IPPV (OR 1.21, CI95% 1.05-1.39, p=0.007). The variable comparing men and women's fertility desires included in the fully adjusted model (Table 7.5) showed a contrasting effect on the risk of IPPV or IPSV; in line with the prediction, men who want more children or sooner than their wives, had higher odds of perpetrating IPPV (OR 1.12, CI95% 1.01-1.23, p=0.025). Women who want more children or children sooner than their husbands, had higher odds of experiencing IPSV (OR 1.211.05-1.39, p=0.008).

The paternal disinvestment variables were significantly associated with IPPV. The fully adjusted model (Table 7.5) showed that the risk of IPPV was higher in marriages where the husband has more living children than their wife (OR 1.12, CI95% 1.02-1.24, p=0.015), is polygamous and has had extra-marital sex within the past year (OR 1.24, CI95% 1.09-1.41, p=0.001 and OR 1.31, CI95% 1.31-1.41, p<0.000). Interactions between marital type, extra-marital sex incidence and difference in living children were run to assess whether men who are polygamous and have had extra-marital sex are the same men who have more living children than their wives. The interactions were not significant which suggests that the same individuals were not causing the statistical effect. Women's economic independence does not have a protective effect against IPPV.

By contrast to IPPV, men who are polygamous and have had extramarital sex did not have higher odds of perpetrating IPSV, but men with more living children than their wives were shown to be

more likely to perpetrate IPSV (OR 1.14, CI95% 1.02-1.28, p=0.020) in the fully adjusted model. Women in employment were at higher risk of IPSV compared to women who are not working. This was irrespective of whether they are not paid (OR 1.15, CI95% 1.35-1.79, p<0.000), paid in cash (OR 1.66, CI95% 1.01-1.35, p=0.028), or paid in a mixture of cash and kind (OR 1.16, CI95% 1.37-2.01, p<0.000).

The fully adjusted model (Table 7.5) showed that the variation explained at the country and ethnic group level is higher for the IPSV model than for the IPPV models (a total of 17.7% compared to 7.6%) which suggests that more of the variation in IPPV is explained by individual level factors.

A combined model in which all variables from the fully adjusted models testing both paternity concern and reproductive conflict (Table 7.3 and Table 7.5) were included in one model (Table 7.6). This shows that with exception of the number of living children, the variables retain significance in both the IPPV and IPSV models.

7.7 DISCUSSION

The aim of this study was to test for an ultimate motivation for male IPV perpetration (Tinbergen, 1963). Hypotheses relating to evolutionary sexual conflict were tested using couples' data from 12 countries in sub-Saharan Africa. Overall the results provide stronger evidence that physical IPV rather than sexual IPV perpetration may have an evolutionary motivation. Physical IPV was associated with indicators of paternity concern and indicators of reproductive conflict (specifically paternal disinvestment) whereas sexual IPV perpetration was only associated with indicators of paternity concern.

Paternity concern is put forward as an explanation for a wide range of male behaviours (Dickemann et al., 1981;Buss, 1996;Goetz et al., 2008). However, the importance of paternity concern as a motivating factor for men's behaviour is uncertain. Men are thought to assess the risk of non-paternity using indirect cues such as mate fidelity or child resemblance (Anderson, 2006). Population studies using genetic testing have estimated non-paternity rates from 1-2% to 10% which vary by context, including kinship structure (Larmuseau et al., 2016;Anderson, 2006). Low non-paternity rates could either indicate that extra-pair sex among women is uncommon, or it could indicate that male behaviours motivated by paternity concern have been effective (Larmuseau et al., 2016). Observations of high paternity certainty assessed through genetic testing have been attributed to societal mechanisms which control women's sexual behaviour (Strassmann et al., 2012).

The results of this study provide some evidence that paternity concern may be a motivating factor for IPV in this sample (Table 7.2 and Table 7.3), and that men are more likely to perpetrate both IPPV

and IPSV when the perceived risk of their wife engaging in extra-pair sex is higher. Firstly, men who were reported to exhibit jealousy, make accusations of infidelity, and insist on knowing where their wife is at all time, have significantly higher odds of perpetrating both IPPV and IPSV. The association of these behaviours with IPPV and IPSV is similar, which supports the prediction that all types of IPV, not just IPSV, may be forms of sexual coercion related to men's concern about their wives' infidelity (Goetz and Shackelford, 2009). Here, controlling behaviours were used as proxies for paternity concern, whereas they could also be considered as outcomes of paternity concern like IPPV and IPSV. However classified, these results confirm the positive association found in the literature between men's controlling behaviours and IPV perpetration (Antai, 2011;Garcia-Moreno et al., 2006;Jewkes, 2002;Heise, 2012;Mandal and Hindin, 2013;Hayes and van Baak, 2017).

Secondly, only indicators relevant to the wife's sexual activity were significantly associated with an increased risk of IPPV and IPSV (Table 7.2 and Table 7.3). Indicators of the husband's sexual activity, and of sexual activity by men or women within the ethnic group, have a small and non-significant association. This suggests that men are primarily attuned to their wives' sexual behaviour and their own personal risk of non-paternity, rather than a more general threat posed by the behaviour of others in the group. In the full model (Table 7.6) men's controlling behaviours and women's number of sexual partners retained significance. Together, these results suggest that the hypothesis that men exposed to indicators of paternity concern have higher odds of perpetrating both IPPV and IPSV cannot be rejected. According to theory, the potential fitness benefit gained by men from IPV triggered by paternity concern is to reduce their non-paternity rate, rather than to increase their own fertility. Genetic testing however would be required to assess whether IPV perpetration is associated with lower rates of non-paternity.

In addition to IPV, women's extra-pair sex that results in pregnancy may also be grounds for divorce, as well as the return of bridewealth where this is an element of marriage ceremonies, both of which can be socially and financially devastating for the woman and her family (Ogbu, 1978). However, extra-pair sex resulting in pregnancy will not always be cause of IPV or divorce and the consequences for children fathered by men other than their social fathers will depend on the social and individual context. It is common for the social father to have legal rights over his wife's children, irrespective of paternity (Clark et al., 2015). In much of sub-Saharan Africa infertility is a social stigma for men, and a wife's extra-pair sex may be acceptable in such cases (Dyer, 2007). Elsewhere, as in Ghana, the consequences of having children conceived outside the marriage depend on the relationship between the biological and social father. It has been documented that the child will be accepted and the wife will not be 'punished' if the biological and social father are from the same patrilineal descent group (Lobnibe, 2005).

The reproductive conflict model tested two motivations for IPV; achieving higher fitness within or outside marriage (Table 7.4 and Table 7.5). The evidence that men use IPV to achieve higher fitness within their marriage is weak. In line with the predictions men's fertility preferences alone are not significantly associated with IPPV, whereas men with higher fertility preference compared to their wives' have a small but significant increase in the odds of perpetrating IPPV. The results showing that there is an increased risk of IPSV perpetration in marriages in which the wife's fertility preferences are higher than her husbands' are difficult to interpret.

Stronger support for the paternal disinvestment hypothesis is found, in which conflict arises when men seek to increase their fitness outside the marriage. The results show that the odds of IPPV are significantly higher where men have more living children than their wives, are polygamous, and have had extra-marital sex in the past year. These are all situations in which men may be diverting resources away from their wives' households, potentially enhancing their own fitness to the detriment of their wife's. The paternal disinvestment theory proposes that marital conflict relating to these circumstances escalates into IPPV, rather than being driven by a sexual or reproductive motive. Accordingly, fewer associations are found between paternal disinvestment proxies and IPSV.

The higher odds of IPPV perpetration in polygamous marriages also supports the paternal disinvestment predictions, rather than predictions based on reproductive conflict theory (that polygamous men would be less likely to perpetrate IPPV as they can achieve higher fitness with multiple wives). Women in polygamous marriages are faced with paternal disinvestment on a daily basis, as their husbands invest resources in the broadest sense on their co-wives and their co-wives' offspring. This could cause female 'resource' jealousy, escalating into IPPV. However contrary to predictions, women in employment who may have less financial reliance on their husbands and less cause for 'resource' jealousy, do not have a reduced risk of IPPV. By contrast, women in any kind of employment are at a significantly higher risk of IPSV. Rather than providing economic independence, women's earnings and the use of them, may be a trigger for conflict within a marriage (Vyas and Watts, 2009).

Pair bonding is a common feature of human society, and is argued to be an adaptive strategy providing both men and women with fitness benefits (Chapais, 2013). However, the stability of human pair bonds are anticipated to vary in relation to environmental cues, such as the availability of alternative partners and the operational sex ratio (Borgerhoff Mulder and Rauch, 2009). In partnerships that are less stable and potentially terminating, the paternal disinvestment theory presents a valid explanation for IPPV. In this scenario the fitness costs associated with men's defection from the relationship are lower, particularly if an alternative partner has already been

found. Operational sex ratios and divorce rates, as indicators of availability of alternative matting opportunities within the community, would be needed to verify this. Further, detailed observational data is also needed to understand the sequence of events leading from paternal disinvestment behaviour to IPPV incidence.

Reproductive conflict theories anticipate that IPV would lead to a direct fitness benefit, which in this study was tested using proxies for fitness. To my knowledge, only one evolutionary study has tested for an association between IPV and male reproductive success, finding that IPPV perpetration predicts greater marital fertility (IPSV was not tested) (Stieglitz et al., 2018). The authors speculate that these results may be caused by reproductive coercion or paternity concern, or a combination, but this is not specifically tested.

These findings also provide an insight into the relationship between IPPV and IPSV. A number of factors suggest that IPSV occurs in addition to IPPV; more women who experienced IPPV also experienced IPSV (55.6% compared to 29.7%), more women experienced IPPV than IPSV in all countries except Malawi; and experience of IPPV is more strongly associated with experience of IPSV analysis than in the opposition direction. However, the two behaviours do not necessarily co-occur and 44.3% of women only experienced IPSV without reporting IPPV during the same period (955 out of 2153 women). It is possible that these women did experience IPPV, but not during the 12 months captured in this survey.

The results suggest that IPSV or IPPV may be triggered by different motivating factors. Firstly, fewer control variables are significantly associated with IPSV than IPPV. Notably childhood exposure to IPV, husband's education, husband's age and household location are not significantly associated with IPSV, and husband's alcohol use has a smaller (although also significant) association with increased risk of IPSV than of IPPV. Secondly, the results show that indicators of paternal disinvestment are not significantly associated with IPSV, whereas indicators of paternity concern (the number of the wife's sexual partners) has a stronger association with IPSV than IPPV. The differences between IPPV and IPSV needs further exploration in future studies, but if the triggers are different, then different intervention strategies may be required. Current intervention strategies do not typically distinguish between IPV types (Devries et al., 2013b).

The overall finding that IPSV is associated with fewer control or experimental variables than IPPV supports other findings in the literature (Appendix Table 7.1). This may reflect the smaller sample size for IPSV which reduces the power of the analysis. Alternatively, the weaker association between IPSV and the proxy indicators for evolutionary motivations may indicate that IPSV serves no fitness benefit. IPV of all types carry numerous evolutionary costs, and it seems likely that IPSV carries

higher costs than IPPV, and men may achieve higher fitness in their intimate partnerships by using less costly strategies.

7.8 STUDY LIMITATIONS

As this study uses cross-sectional data, the precise sequence of events between the IPV experiences and some of the experimental variables is not known. To allow for this, control and experimental variables were selected which can be matched as closely as possible to the timeframe of the IPV incidence. The large data sample compensates to a certain extent for the lack of detailed time-sequence events, however, there is still ambiguity for some variables.

Proxy indicators were used to test for evolutionary motivations for IPV (Nettle et al., 2013;Mattison and Sear, 2016). However, distinguishing ultimate from proximate motivations for some proxy indicators is not straightforward. Proximate behaviours may be driven by ultimate motivations and the outcomes are often aligned (Tinbergen, 1963;Scott-Phillips et al., 2011;Laland et al., 2013). For example, a wife's extra-pair sex could be a proximate trigger for her husband to perpetrate IPV, but it could also be an ultimate driver if her extra-pair sex threatens his evolutionary fitness as interpreted by the results illustrated in Table 7.4. Proving that IPV perpetration has an ultimate motivation and that it enhances men's evolutionary fitness requires data demonstrating that men gain a fitness benefit from their behaviour which is difficult to obtain. Men's reproductive success is difficult to measure as paternity is uncertain within a marriage, and additional children may have been fathered in other relationships. Therefore genetic data would be required (e.g. (Strassmann et al., 2012)).

In this study men's IPV perpetration was obtained from their wives' reports of IPV experience. The potential for inaccuracy in this data is evident as self-reported experiences can be subject to reporting bias; women may intentionally or unintentionally under or over report their experiences or misunderstand the question. However, men's self-report of IPV perpetration would also be subject to the same issues of reporting bias. The DHS aims to reduce reporting bias as the IPV module is administered by interviewers trained in asking about IPV and in this study experience was restricted to the prior 12 months, rather than lifetime experience of IPV, to reduce recall errors. Further, studies which have compared men and women's IPV report indicate that women's self-reported experiences of IPV are as valid as men's self-reported IPV perpetration (Halim et al., 2018;Jewkes et al., 2017;Hoffman et al., 1994;Barker et al., 2015).

Not all variables that have been found to be associated with IPV are controlled for in these models (Heise, 1998). Some variables are not collected by the DHS (e.g. men's non-partner violence, men's

drug use, indicators of men's mental health, or the reason for the conflicts which precede IPV). Other variables occur at too high or low frequency for their inclusion in the statistical models to be meaningful, for example men's employment status (93.6% of men in this sample are employed). Likewise variables which would be relevant to further exploring evolutionary motives were not available such as indictors of parental investment, sex ratios within the ethnic group, kinship residence patterns, or the presence of relatives, all of which are anticipated to affect IPV prevalence (Smuts, 1992;Borgerhoff Mulder and Rauch, 2009).

7.9 CONCLUSION

In this study multilevel logistic regression models using couples' data from 12 sub-Saharan African countries were used to test whether evolutionary sexual conflict may explain men's IPV perpetration, analysing physical (IPPV) and sexual (IPSV) violence separately. It is proposed that evolutionary sexual conflict, resulting from men and women's different evolutionary fitness goals, may provide an ultimate level explanation for IPV perpetration (Borgerhoff Mulder and Rauch, 2009;Parker, 1979;Figueredo et al., 2012). Two hypotheses based on this theory were tested; 1) IPV is perpetrated in response to their wives' actual or perceived risk of extra-pair sex, 2) IPV is perpetrated as a result of reproductive conflict causing men to pursue a higher fitness optima than their wives, either within the marriage (reproductive coercion) or with alternative partners outside the marriage (paternal disinvestment).

The results show differing support for both hypotheses by IPV type. Indicators of paternity concern increase the odds of IPPV and IPSV perpetration. An evolutionary interpretation is that men are attuned to their partner's sexual behaviour and their own specific risk of non-paternity, and IPV is perpetrated where the perceived risk is higher. Evidence that reproductive conflict, resulting from men and women's differing fitness optima, being associated with IPV is mixed; indicators of differing fertility preferences show a weak association with IPV of either type; however paternal disinvestment indicators show a stronger association IPPV but not IPSV perpetration. Men who are polygamous, have more living children than their wife, and engage in extra-marital sex are shown to be more likely to perpetrate IPPV. An evolutionary interpretation is that marital conflict over paternal investment being diverted from the wife's family unit is evidence of men and women's differing evolutionary goals. To compensate for the considerable fitness costs associated with men perpetrating IPV, it is predicted that men will be more likely to 'disinvest' in contexts where there is a greater availability of alternative mates. Marriage in many sub-Saharan contexts can be an informal and fluid process, rather than a binary process, involving a varying number of steps over time until a union is considered final (Meekers, 1992; Bledsoe & Pison, 1994). Divorce is relatively

easy to obtain in many sub-Saharan African contexts, with approximately 25% of marriage ending in divorce within 20 years (Clark, 2015). In contexts where bridewealth has been paid, men may choose not to divorce and repay bridewealth, but instead pursue informal relationships outside their marriages (Lloyd, 1968). IPPV resulting from paternity concern or paternal disinvestment are not mutually exclusive, and it is anticipated that depending on context, different triggers may be more important. The full model (Table 7.6) shows that when all variables relating to both paternity certainty and reproductive conflict are included in the same model, the wife's sexual activity, polygamy and male extra-pair sex retain the same association with IPV perpetration.

However, IPV as a fitness enhancing strategy is questioned, and in this study the fitness outcomes of men's behaviours are unknown. The applicability of Bateman's theory to humans has been questioned (Brown et al., 2009). In long-term pair bonds, men will have a vested interest in cooperating with their wives to enhance the health and survival of the offspring they share together, as a couples' fitness is closely tied (Moya et al., 2016;Chapais, 2013). Evidently not all men perpetrate IPV even in societies in which IPV is commonplace, which suggests that alternative strategies exist. Limited studies have looked at positive male attentiveness to their partners or perceived attraction of their partners following their absence as an alternative to violence (Shackelford et al., 2002). It is anticipated that fitness costs and benefits associated with IPV will vary, for example due to variation in social sanctions against IPV or threat of retaliation from the wife's kin. In this study men's IPV perpetration is shown to relate to factors which could indicate that evolutionary sexual conflict is a motivating factor, in certain circumstances.

These results demonstrate that an evolutionary approach can enhance our understanding of male-to-female IPV. This has the potential to explain why IPV is more prevalent in some societies than others by identifying evolutionary gains. Furthering our understanding of ultimate explanations for IPV can be used to inform policy, complementing the knowledge gained from non-evolutionary studies (Gibson and Lawson, 2014). Here, distinct risk factors are identified for IPPV and IPSV perpetration which suggest that targeted programmes are needed to tackle IPPV and IPSV separately. The proxy indicators used in the models to test both evolutionary theories have been shown in previous studies to be associated with IPV. Here these variables are placed in an evolutionary framework which gives context and explanation for why these particular factors might increase the risk of IPV.

CHAPTER 8 TESTING FOR AN ASSOCIATION BETWEEN FGC AND IPV IN SIX COUNTRIES IN SUB-SAHARAN AFRICA

Abstract

The term 'violence against women and girls' (VAWG) describes behaviours specified in the United Nation's 1993 Declaration on the Elimination of Violence Against Women, which includes female genital cutting (FGC) and intimate partner violence (IPV). It is frequently asserted that all forms of VAWG have the same root causes, namely patriarchal norms and gender inequality, and as such can be tackled collaboratively. The proposal that women experience a continuum of violence throughout their lives, through poly-victimisation or revictimisation, has gained support in development and policy literature.

A recent UN policy note encourages strengthening policy linkages between FGC and IPV programme work whilst also acknowledging the research gaps in the literature concerning the correlated prevalence of these two behaviours (UN Women, 2017a). Here, the two specific research gaps identified are addressed, using DHS data from 6 sub-Saharan African countries selected according to specific inclusion criteria, and examine a) whether women with FGC are more susceptible to IPV, and b) whether women's IPV experience is associated with their support for the continuation of FGC.

No association between IPV and FGC is found in this sample. Multilevel multivariate logistic regression analysis shows that the association between FGC status and women's risk of experiencing IPV is small and not statistically significant, and women who have experienced IPV are not statistically more likely to support the continuation of FGC. Further, the importance of individual and community values varies for each behaviour; FGC support is more influenced by ethnic group characteristics, while IPV is more influenced by individual level factors. Together these results suggest that grouping FGC and IPV interventions together needs further evidence. Eradication programmes may be more effective if targeted at specific behaviours, and at the community or individual level as appropriate.

8.1 INTRODUCTION

Female genital cutting (FGC) and intimate partner violence (IPV) affect the health and well-being of millions of women and girls. Addressing both FGC and IPV are urgent international development priorities (UN, 2016). It is estimated that globally 30% of women experience IPV during their lifetime (García-Moreno et al., 2013), and that 100-200 million women alive today have undergone FGC with a further 3 million girls at risk of being cut every year (WHO, 2014). FGC is defined as all procedures

involving partial or total removal of the external female genitalia or other injury to the female genital organs for non-medical reasons (WHO et al., 1997). IPV is defined as any behaviour within an intimate relationship that causes physical, psychological or sexual harm (WHO, 2012a). Although IPV can be perpetrated by men and women (and some argue that the incidence of IPV perpetration by men and women is equally common (Archer, 2000)), the focus of this study is specifically male-to-female IPV.

The profiles of FGC and IPV are very different (summarised in Table 8.1). FGC is a highly contextualised one-off practice found in specific communities, imbued with religious or cultural significance, arranged by a girl's family and often followed by a public celebration. By contrast IPV is a worldwide phenomenon perpetrated in private, often recurrently, by a woman's partner or husband. Although found worldwide, IPV is not assumed to be a universal or innate feature of male behaviour, but one that is expressed according to development and ecological context (Mameli and Bateson, 2006). FGC results in a physical and permanent change which is objective in its identification, whereas the recurring nature of IPV means that women's experiences are transient and may change over their lifetime. Despite these differences it is commonly suggested that FGC status and IPV experience are associated, and this assertion is examined within this paper (UN Women, 2017a;Shell-Duncan, 2004;Barbaro, 2017).

The United Nations' 1993 Declaration on the Elimination of Violence against Women recognises violence against women and girls (VAWG) as a violation of human rights and compels all member states to eliminate VAWG (UN General Assembly, 1993). The declaration provides a comprehensive definition of VAWG that covers a wide range of physical, sexual and psychological behaviours perpetrated against women both within and outside the home, and which includes FGC and all forms of IPV. The elimination of IPV and FGC is also specified in Goal 5 of the United Nation's Sustainable Development Goals (SDGs) which aims to achieve gender equality and empower all women and girls by 2030 (UN, 2016).

There is increasing evidence (discussed in Section 8.1.2) that many women experience multiple forms of VAWG. Joint eradication programmes which could reduce the prevalence of several forms of VAWG simultaneously, thereby increasing programme efficiency and making greater progress towards the SDGs, are a compelling proposition for policy makers. Likewise practitioners have long-urged policy makers to recognise the overlapping nature of different types of VAWG and design interventions to target VAWG together rather than in isolation (Bott et al., 2005;Yount et al., 2017;MIGS, 2015), although there is limited evidence of success (Ellsberg et al., 2015;Arango et al., 2014). Recently this approach has been extended to include FGC. In 2017 the UN released a policy

note calling for increased coordination and collaboration in policy work between IPV and FGC specifically (UN Women, 2017a;UN Women, 2017b). However, although FGC and IPV are often grouped together either under the VAWG umbrella, or as examples of gender-based violence (GBV) or harmful cultural practices, their co-occurrence is not well-documented and there are some fundamental differences in their profile (see Table 8.1) (UN, 1995).

Here the empirical evidence and theoretical basis for the co-occurrence of VAWG is reviewed first, and then the evidence specifically relating to IPV and FGC is discussed.

8.1.1 Co-occurrence of different forms of VAWG documented in the literature

Many women and girls experience more than one form of VAWG in their lifetime (Khan, 2000). This has been conceptualised in a range of ways. The phrase 'continuum of violence' was coined by sociologists to describe the sequential nature of violence experienced by some women throughout their lifetime (Kelly, 1987), which is also referred to as a life-cycle framework (Watts and Zimmerman, 2002;Solotaroff and Pande, 2014;Gennari et al., 2014). In international development policy literature, the role of gender inequality is emphasized in relation to women's interlinked experiences of childhood abuse, early or forced marriage, FGC and IPV (MIGS, 2015). Likewise, poly-victimisation is also used to describe women and girls' experiences of multiple forms of violence, experienced either concurrently or sequentially, drawing attention to the augmented impact this has on a victim's trauma symptoms (Finkelhor et al., 2007;Yount et al., 2017;Turner et al., 2016).

Empirical evidence demonstrating the co-occurrence of different types of VAWG (such as psychological, physical and sexual violence either within the home or within the community) is well-established (Antai, 2011;Garcia-Moreno et al., 2006;Jewkes, 2002;Heise, 2012;Mandal and Hindin, 2013;Hayes and van Baak, 2017). The co-occurrence of IPV with other types of VAWG has also been demonstrated, such as IPV and early marriage (Kidman, 2017), and IPV and non-partner violence (Abramsky et al., 2011;Campbell et al., 2008;Krebs et al., 2011;Wahab and Olson, 2004;Raghavan et al., 2006).

There are two primary theoretical explanations for the co-occurrence of different forms of VAWG. At the individual level, psychologists have focused on the phenomenon of revictimisation, whereby abused children are at greater risk of experiencing IPV or other forms of VAWG in adulthood (Desai et al., 2002;Barnes et al., 2009;Classen et al., 2005;Messman and Long, 1996;Lalor and McElvaney, 2010). The mechanisms underlying revictimisation are not yet understood. Many explanations focus on the psychological sequelae resulting from childhood abuse, such as alcohol and drug use, post-traumatic stress, dissociation, and poor risk recognition, all of which increase the odds of being

revictimised (Messman-Moore and Long, 2003;Kennedy, 2008). It is also proposed that childhood abuse may interfere with emotional development which affects victims' regulation and tolerance for abuse in adulthood (Peltzer and Pengpid, 2014).

An alternative explanation for the co-occurrence of different forms of VAWG relates to societal structure and values. Accordingly, all forms of VAWG are explained by men's desire to dominate and control women, and that these behaviours are maintained in society by the patriarchy and gender inequality (UN Women, 2017a). Developing this further, it is argued that VAWG share the same root cause and persist due to inter-connected social norms which contribute to their co-occurrence (CEDAW/CRC, 2014). Social norms are defined as 'shared beliefs about what is typical and appropriate behaviour in a valued reference group, maintained by approval/disapproval by the reference group' (Alexander-Scott et al., 2016). The concept of intersectionality is also drawn upon, suggesting that women at the intersection of societal systems (such as ethnicity, class, religion, socio-economic status) face multiple forms of oppression in the form of VAWG (Kelly, 1987;Fulu et al., 2014).

8.1.2 Co-occurrence of FGC and IPV documented in the literature

Scholars and policy makers have cited both the societal and individual explanations when predicting an association between IPV and FGC. Some have proposed that an association between FGC status and IPV experience may be explained by revictimisation (Peltzer and Pengpid, 2014;Salihu et al., 2012). More commonly it is suggested that IPV and FGC share the same root cause, and that both behaviours are intended to control women and are maintained by patriarchal values and gender inequality (UN Women, 2017a;Shell-Duncan, 2004;Barbaro, 2017). Patriarchal control is difficult to prove empirically, and the idea of shared drivers is challenged by studies which have demonstrated that different risk factors appear to be driving the prevalence of FGC and IPV; FGC is motivated by parent's concerns about social acceptance and marriageability, and men typically state similar or lower levels of support for the practice than women (Varol et al., 2015;Yoder and Wang, 2013;Gage and Van Rossem, 2006) (although this is challenged by recent studies revealing older, educated men's hidden support for FGC (Gibson et al., 2018)); whereas IPV perpetration appears to be more determined by men's individual circumstances, such as witnessing parental violence, alcohol use and involvement in community violence (Fleming et al., 2015). Other studies suggest that the interaction between FGC with IPV is more nuanced, for example describing FGC and other cultural practices as behaviours which may increase a woman's vulnerability to IPV, rather than relating them to a shared root cause (Gennari et al., 2014).

Table 8.1. FGC and IPV profile comparison

	FGC	Male-to-female IPV
Victim Profile:		
Gender	Exclusively women and girls.	Women
Age	Normally before marriage. In West Africa girls are often cut in infancy. Elsewhere girls are cut in later childhood, during puberty, or prior to marriage.	Any age after marriage/cohabitation. Younger women are at greater risk of violence, although victims can be any age.
Risk factors	FGC prevalence in community, parental beliefs. Usually the girl has no influence.	Victim profile tends to be younger women, married at a younger age, with low education, who have been exposed to IPV in childhood. Key risks relate to partner's characteristics.
Perpetrator profile:		
Gender	Usually female (e.g. traditional practitioner)	Male
Relationship	Procedure usually arranged by female members of the girl's family	Husband/intimate partner
Motivation	Varies. Motivations for practitioner are financial and related to status. For the family, motivations include: social acceptance, religion, marriageability, following tradition, beliefs about beneficial consequences.	Motivations rarely captured. Where articulated, examples include; anger at woman's behaviour, punishment, jealousy, and demonstrating authority over wife.
Risk factors	Prevalence in ethnic group, mother's FGC status, mother's education and religion	Alcohol use, low education, social norms surrounding IPV, adverse childhood experiences.
Behaviour profile:		
Geography	Commonplace in 29 countries, and found in diaspora communities globally.	Global, ranging from 23-40% nationally. Recorded in all societies.
Ceremonial element	Varies. Planned procedure which may be followed by ceremony or celebration.	None. May be spontaneous or premeditated. Usually takes place in private.
Occurrence	Usually once, although some women are re-infibulated following childbirth.	Often recurs. Frequency varies.
Visibility	Only visible with genital examination. FGC status of girls in community often common knowledge due to ceremonies.	Only revealed through questioning.
Variability	Very varied. FGC covers a range of procedures which vary in severity, health consequences and profile.	Very varied. IPV covers a range of behaviours which vary in severity, health consequences and profile.

Empirical evidence testing the relationship between FGC and IPV (or FGC and any other type of VAWG) is limited. To my knowledge only five studies have been conducted to date, all using Demographic Health Survey (DHS) datasets, four of which found a positive association between FGC and IPV. A study using Egypt DHS data found that women with FGC had higher odds of experiencing IPV, although only 2.9% of the total sample did not have FGC (Refaat et al., 2001); a study using Ivory coast DHS data found a statistically significant positive association between FGC status and sexual

IPV, but not other forms of IPV (Peltzer and Pengpid, 2014); an unpublished master's thesis using Kenya DHS data also found a significant positive association between FGC status and IPV (Ramage, 2018); and a study using Mali 2006 DHS data found a positive statistically significant association between FGC and all subtypes of IPV, and also found that women with the most severe form of FGC had twice as high odds of experiencing IPV (Salihu et al., 2012). However, a subsequent study using Mali 2013 DHS data did not find a positive association (Hayes and van Baak, 2017). The authors variously attribute these associations to revictimisation (Peltzer and Pengpid, 2014;Salihu et al., 2012), gender imbalance or intersectionality (Refaat et al., 2001).

Likewise, few studies have examined the association between women's endorsement of both practices (i.e. support for the FGC continuation, and agreement with IPV justifications). A positive association has been found in Benin, Ethiopia, Eritrea, and Mali, whereas this is not the case in Nigeria, and the evidence from Egypt appears mixed (UNICEF, 2005b;Refaat et al., 2001;Afifi, 2009;Yount and Li, 2009).

8.1.3 Eradication policy and research gaps identified by UN Women

Huge aid budgets are spent addressing both behaviours (e.g. the Department for International Development (UK) recently pledged £50m and £184m between now and 2030 toward FGC and IPV programmes respectively). Numerous approaches have been tried to reduce both behaviours; FGC interventions include criminalising the practice, education campaigns about health risks, collective community abandonment, or introducing alternative ceremonies; IPV interventions include parenting programmes to reduce childhood exposure to violence, reducing alcohol abuse, promoting women's economic empowerment, and legal and justice reform. Social norms change which engages communities to challenge beliefs and discuss alternative norms has been used to address both IPV and FGC. However, changing FGC and IPV behaviour has proved challenging, and the most effective strategies remain unclear, particularly as evidence-based evaluations of programmes aimed at reducing either behaviour are lacking (Heise, 2011;Berg and Denison, 2012b).

To my knowledge no joint programmes have been attempted to reduce FGC and IPV together. A small number of programmes which have used a social norms change approach to either address FGC or IPV, claim to have had an indirect effect on reducing the other behaviour. Two IPV intervention programmes, one in Kenya and one in Ethiopia are said to have also led to the abandonment of FGC, although the details are unclear (UNICEF, 2010). An FGC eradication programme run in Senegal by a non-governmental organisation called Tostan, where participants attended modules on human rights, hygiene, women's health and problem solving, reported a decrease in IPV as well as FGC (Diop, 2004). Much weight has been given to the Tostan result, which

has been widely cited and used to promote the use of multiple programme interventions as a means of accelerating FGC and IPV change (Gillespie and Melching, 2010;UNICEF, 2008;UN Women, 2017a;Gennari et al., 2014;Heise, 2011;Ellsberg et al., 2015). However, the report in which these results are described is not peer-reviewed, the sample sizes are small (n200 women, n198 men) and the methods, results data and statistical analysis are unclear.

Therefore, it remains to be established whether FGC and IPV can be tackled effectively together within a VAWG framework. The UN Women paper which advocates strengthening policy linkages between IPV and FGC interventions recognises two major knowledge gaps; firstly, whether women with FGC are more susceptible to IPV; and secondly, whether women's experience of IPV influences their support for FGC continuing (UN Women, 2017b). These gaps are addressed here by testing the following hypotheses;

Hypothesis 1: Women with FGC have a higher risk of experiencing IPV

This hypothesis is testing the prediction made by the UN Women paper, however, the opposite prediction could equally be made; that men married to women with FGC (already under patriarchal control and with controlled sexual desire) have less cause to resort to violence.

Hypothesis 2: Experiencing IPV increases women's support for FGC

This hypothesis tests whether women who have experienced IPV in the previous 12 months are more likely to state support for FGC, controlling for their FGC status and ethnic group FGC prevalence.

8.2 METHODS

8.2.1 Data and Sample

DHS datasets were used for this study. These are nationally representative surveys conducted by the United States Agency for International Development and the host government, in around 60 low- and middle-income countries globally. DHS surveys are standardised across countries, and data is collected on a range of subjects including socioeconomic profile, reproductive and maternal health, marriage and sexual activity. Additional optional modules on IPV and FGC are also available. Where used, all women are asked about their FGC status and the IPV module is conducted on one woman per household.

For this study, global coverage was restricted to sub-Saharan Africa, where FGC is most prevalent. Thirteen of the most recent country surveys used the IPV and FGC modules and these datasets were

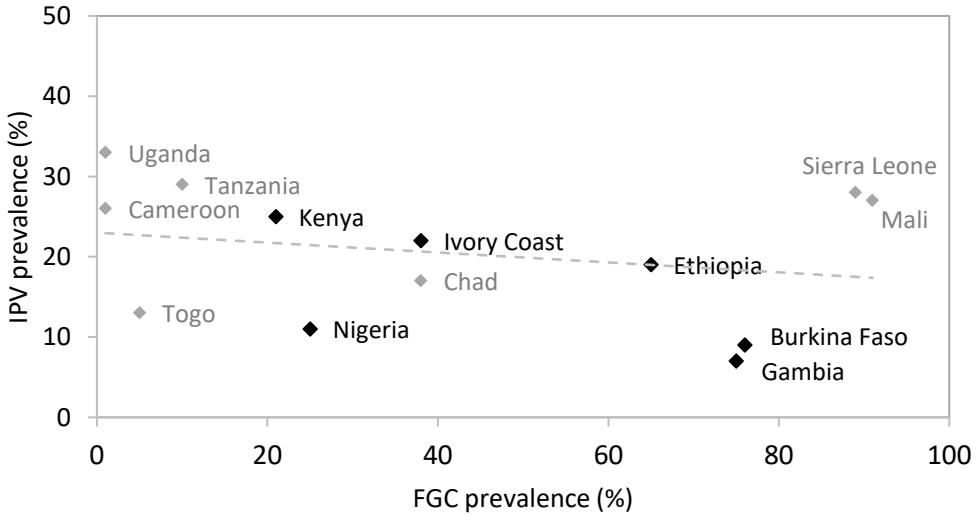
assessed for suitability in the study (see Figure 8.1). Countries in which FGC prevalence was greater than 90% in all ethnic groups (Sierra Leone, Mali) or less than 10% in all ethnic groups (Uganda, Cameroon, Togo) were excluded. Chad was also excluded because there was no overlap between women with FGC who were sampled for the IPV module, and Tanzania was excluded because ethnic group information was not collected from respondents. The remaining six countries were suitable for analysis; Kenya (2014), Nigeria (2013), Gambia (2013), Ivory Coast (2012), Burkina Faso (2010) and Ethiopia (2008) (n33,689 women).

The FGC profile is similar in the six study countries. The average age at FGC is between 2.5 – 4.7 years in all countries except Kenya where it is 11.2 years. In all six countries the most common form of FGC is flesh being removed from the genitals. This was experienced by 81 – 96% of women with FGC except Nigeria (67%). Overall, 79% of women had flesh removed from their genitals, 8% were cut but no flesh removed, and 8% were infibulated. The remaining 6% did not know or did not answer concerning FGC type.

The legal context regarding FGC and IPV varies. FGC is now illegal in all six countries, at the time of the DHS surveys used it was still legal in the Gambia and some states of Nigeria. In Burkina Faso and Ivory Coast, it was illegalised over 20 years ago. Penalties associated with FGC perpetration vary, and prosecutions are uncommon in all countries (28 Too Many, 2018). The legal status regarding IPV is mixed; legislation or legal recourse against domestic violence exists only in Ethiopia and the Gambia, and against marital rape exists only in Nigeria, Ivory Coast and Burkina Faso (World Bank, 2018).

Figure 8.1. IPV and FGC prevalence in 13 countries in which DHS collected IPV and FGC data

Countries in bold are used in this study, data from the other countries was unsuitable.



8.2.2 Data analysis

The same datasets were used to test both hypotheses. Unmarried women, and women whose FGC status, IPV experience or ethnic group were unknown were excluded. Respondents from ethnic groups with fewer than 50 women were also excluded. Otherwise all women with available data for the selected variables were used in the analyses (n31,067 for hypothesis 1, n31,170 for hypothesis 2).

Hypothesis 1: Women with FGC have a higher risk of experiencing IPV

The outcome variable was women's experience of physical and/or sexual IPV during the 12 months preceding the survey. Restricting IPV experience to a specific recent timeframe reduces recall bias and allows the control variables to be matched temporally as far as possible to the IPV experience. The DHS asks respondents about several specific experiences relating to physical IPV (being pushed, shaken, slapped, punched, kicked, dragged, beaten up, choked or attacked with a weapon) and sexual IPV (being forced, physically or in any other way, to have sexual intercourse, or perform sexual acts). Women who reported that they had experienced one or more of these behaviours, either sometimes or often, were coded as having experienced IPV.

FGC status is the key predictor variable of interest. The DHS asks women whether they are circumcised (translated into their local equivalent), and women who had experienced any form of FGC were coded as cut.

The statistical models control for variables which have been shown in previous studies to affect the risk of women experiencing IPV (Abramsky et al., 2011;Garcia-Moreno et al., 2006;Jewkes et al., 2017). These variables are household wealth (using the DHS quintiles), household location (rural or urban), woman's age, woman's education (categorised as none, primary, and secondary or higher), and marriage type (polygamous or monogamous). The model also controls for whether the husband drinks alcohol as reported by his wife (yes or no), whether the woman was exposed to IPV in childhood (whether her father beat her mother) as both these variables have been shown to be highly predictive of IPV experience (WHO, 2012a).

Two indicators of female empowerment are included in the model as studies have shown that women with more autonomy have a lower risk of experiencing IPV (Rahman et al., 2013;Benebo et al., 2018). The first is the number of controlling behaviours exerted by their husbands, taken from women's responses to DHS questions about five possible behaviours (whether their husband is jealous or angry if she talks to other men, frequently accuses her of being unfaithful, does not permit her to meet female friends, insists on knowing where she is at all times, or tries to limit her contact

with family). The second is the number of household decisions women participate in out of four possible decision; their own healthcare, large household purchases, what is done with the husband's earnings, and visits to friends or relatives. Women who solely or jointly make these decisions were coded as participating.

Men's attitudes towards IPV in each ethnic group were included in the model to control for social acceptance of IPV which varies by community, and which may be associated with IPV perpetration (Jewkes et al., 2015;Benebo et al., 2018;Alexander-Scott et al., 2016). Male attitudinal data was extracted from the male DHS datafiles for the same countries and ethnic groups. Men are asked whether 'wife beating' is justified in five different circumstances; if his wife burns the food, refuses to have sex, goes out without telling him, neglects the children, or argues with him. Responses were used to calculate the average number of statements agreed with by men in each ethnic group.

Hypothesis 2: Experiencing IPV increases women's support for FGC

The outcome variable is women's support for FGC. Women are asked whether they think that FGC should be stopped or continued. Women who were undecided or said they didn't know were excluded from the analysis (n1,600). Although women's stated support for FGC may be swayed by the legality of FGC, analysis (not shown here) of Ivory Coast data which asked women if FGC was legal revealed that women's knowledge of the legality of FGC was not associated with their stated FGC support. Alternative measures of FGC support were considered but not deemed suitable; the DHS asks women how many of their daughters have FGC, however it is unknown whether the daughters' FGC procedures were performed before or after any IPV incidence. Some DHS surveys also capture women's intentions to have FGC performed on their daughters, but this was not available for all six datasets used here.

The predictor variable of interest was women's IPV experience in the preceding 12 months. This is the same variable used in Hypothesis 1. Variables known to affect women's support of FGC were controlled for in the models (Gage and Van Rossem, 2006;Masho and Matthews, 2009). Women's own FGC status is the strongest predictor of women's support for FGC (Yount, 2002;Bellemare et al., 2015). Additionally, the models included women's education (categorised as none, primary, and secondary or higher), household wealth (using the DHS quintiles), religion (Muslim, Christian, or None/Other), and women's age. Possible exposure to anti-FGC media campaigns is controlled for by using a composite mass media variable, calculated from women's responses to their use of television, radio and newspapers. Responses are categorised into no exposure, infrequent exposure (less than weekly) or frequent exposure (daily) (Benebo et al., 2018). Additionally, indicators of female empowerment were included as this has been shown to affect women's support of FGC

(Afifi, 2009;Rahlenbeck et al., 2010). Indicators used were the number of controlling behaviours exerted by their husbands, the number of household decisions women participated in, and the number of IPV justifications women agreed with, out the same five described above. Ethnic group FGC prevalence was also controlled for in the models as a contextual level 2 variable.

8.2.3 Statistical analysis

The outcome variables tested in both hypotheses are binary, so multivariate logistic regression analyses were used. Single level models were run on the six country datasets separately, then the data was pooled and used to run multilevel analyses. The DHS data is suited to multilevel modelling due to the hierarchical structure. Individual women are nested in ethnic groups which are nested in countries. Ethnic group affiliation was used as the secondary level as this has been shown to be an important determinant of individual FGC behaviour and provides an adequate sample size for analysis (Yoder and Wang, 2013;Snow et al., 2002;Bellemare et al., 2015;Shell-Duncan et al., 2011). Alternative secondary levels were considered but rejected; regional divisions are often arbitrarily drawn for administrative purposes, and clusters group together households within a similar radius of a specific GPS point but with unknown inter-relationships.

Multilevel models recognise the clustering of data at different levels. This avoids incorrect inferences based on ecological fallacies (Pollet et al., 2015), and allows assessment of the effect of individual and community effects on the outcome variable as well as estimating the extent of variation across communities. There are 73 ethnic groups at level 2, and 6 countries at level 3 in these models. Although there is no consensus on sample size for multilevel analysis, it is generally recommended that it should be more than 15 to avoid standard errors being underestimated (Rasbash et al., 2012b). With just six countries at level 3 there is a possibility that the country-level random variances and standard errors may be underestimated.

The logit multilevel model uses binomial distribution assumptions with second-order linearization and a penalized quasi-likelihood estimation type (Rasbash et al., 2012a). Continuous variables are centred around their grand mean, to ensure that higher level associations are adjusted for individual level characteristics. The model is expressed as

$$\text{Logit } \pi ijk = X'ijk\,\beta + ujk + vjk \quad (1)$$

where πijk is the probability of experiencing IPV (hypothesis 1) or supporting FGC (hypothesis 2) for an individual woman i, in ethnic group *j* in country *k*; *X*′ i*jk* are the covariates defined at levels 1–3, and *ujk* and *vjk* are the residuals at the ethnic and country level, respectively.

Second and third level variance was calculated to understand the variation between ethnic groups and countries regarding the IPV experience and FGC support (the intercepts in the multilevel logistic regression), and to interpret the importance of the different levels on the outcome. The ICC (intra-class correlation), expressed as a percentage, gives a measure of the variance in the logistic outcome attributable to different levels in the model (Snijders, 1999;Goldstein, 2010). The MOR (median odds ratio) expresses the level variance as an odds ratio. High MOR indicate that the contextual effects are more important for understanding the individual probability of experiencing the outcome.

The MOR and ICC are calculated as follows:

MOR = exp(0.95√u_{jk}) (2)

ICC = u_{jk} / (u_{jk}+3.29) (3)

where $u$jk is the residual at the ethnic group level. Predicted probabilities were calculated according the SPSS and MLwiN defaults, which set other continuous parameters to their mean average value, and other categorical parameters to the proportion of cases in each category.

To test hypothesis 1, four multilevel models were run. Model 1 was a null model which showed the variance in IPV experience attributable to the three different levels. Model 2 only included the woman's FGC status. Model 3 included all control variables but excluded woman's FGC status. Model 4 included all control variables and the woman's FGC status. Running separate models allows the effect of FGC status on the variance to be analysed.

To test hypothesis 2, five models were run. Model 1 was a null model which showed the variance in FGC support attributable to the three different levels. Model 2 only included the woman's IPV experience. Model 3 included all control variables but excluded IPV experience. Model 4 included all control variables and the woman's IPV experience. Model 5 additionally included the number of years since anti-FGC legislation was passed as a level 3 contextual variable. National differences in FGC eradication efforts and legislature may influence women's FGC support (Kovacs, 2017), and it is anticipated that stated support for FGC will be lower in countries which have longer-standing anti-FGC legislation.

Table 8.2. IPV experience: Three level multivariate logistic regression models analysing factors associated with women's IPV experience in past year

		Model 1			Model 2			Model 3			Model 4		
		β	S.E.	p-value	β	S.E.	p-value	β	S.E.	p-value	β	S.E.	p-value
Individual variables	cons	-1.809	0.205	0.000	-1.893	0.212	0.000	-2.320	0.149	0.000	-2.379	0.155	0.000
FGC status (No FGC)	FGC				0.143	0.047	0.003				0.092	0.050	0.067
Household wealth (Poorest)	Poorer							0.107	0.061	0.080	0.111	0.061	0.070
	Middle							0.013	0.065	0.846	0.016	0.065	0.805
	Richer							-0.053	0.070	0.446	-0.048	0.070	0.494
	Richest							-0.303	0.083	0.000	-0.292	0.083	0.000
Household location (Urban)	Rural							-0.071	0.053	0.177	-0.071	0.053	0.179
Woman's age								-0.003	0.002	0.168	-0.004	0.002	0.117
Woman's education (None)	Primary							0.096	0.056	0.084	0.099	0.056	0.076
	Secondary +							-0.126	0.069	0.067	-0.118	0.069	0.087
Marriage type (Monog)	Polygamous							0.184	0.048	0.000	0.184	0.048	0.000
Husband drinks alcohol (No)	Yes							0.740	0.045	0.000	0.744	0.045	0.000
Father beat mother (No)	Yes							0.741	0.046	0.000	0.740	0.046	0.000
No. of controlling behaviours wife experiences (0-5)								0.533	0.014	0.000	0.532	0.014	0.000
No. of HH decisions wife involved in (0-5)								-0.022	0.015	0.146	-0.022	0.015	0.147
Contextual variable													
Average number of IPV justifications agreed with by men in ethnic group								0.143	0.111	0.200	0.126	0.111	0.257
Level 2 variance		0.354	0.070		0.353	0.070		0.217	0.047		0.213	0.046	
ICC (%)		9.5			9.7			6.2			6.1		
MOR		0.558			0.564			0.443			0.438		
PCV (%)		ref			-2.3			38.5			1.8		
Level 3 variance		0.215	0.146		0.226	0.153		0.082	0.058		0.082	0.061	
ICC (%)		5.6			5.8			2.3			2.1		
MOR		0.440			0.452			0.272			0.262		
PCV (%)		ref			-5.1			63.7			7.3		

Level 1: Individual women n31,170, Level 2: Ethnic groups n73, Level 3: Countries n6

ICC: Intra-class correlation (proportion of the variation found at that level), MOR: median odds ratio (expresses community variance on an odds scale), PCV: proportional change in variance

Reference group for categorical variables is shown in brackets.

Model 1: Null Model

Model 2: + FGC status

Model 3: Control variables, level 1 and level 2, excluding FGC status

Model 4: + FGC status

Table 8.3. Three level multivariate logistic regression models analysing factors associated with women's agreement that FGC should be continued

		Model 1			Model 2			Model 3			Model 4			Model 5		
Fixed Part		**β**	**S.E.**	**p-value**	**β**	**S.E.**	**p-value**	**β**	**S.E.**	**p-value**	**β**	**S.E.**	**p-value**	**β**	**S.E.**	**p-value**
Individual variables	cons	-1.742	0.347	0.000	-1.759	0.350	0.000	-2.543	0.444	0.000	-2.554	0.444	0.000	-2.444	0.235	0.000
IPV during last 12 months (No)	Yes				0.169	0.051	0.001				0.078	0.056	0.166	0.079	0.056	0.157
Household wealth (poorest)	Poorer							-0.150	0.052	0.004	-0.151	0.052	0.004	-0.152	0.052	0.004
	Middle							-0.292	0.059	0.000	-0.292	0.059	0.000	-0.292	0.058	0.000
	Richer							-0.326	0.066	0.000	-0.325	0.066	0.000	-0.326	0.065	0.000
	Richest							-0.518	0.079	0.000	-0.516	0.079	0.000	-0.513	0.078	0.000
Household location (Urban)	Rural							0.073	0.050	0.144	0.074	0.050	0.138	0.079	0.050	0.113
Woman's age								-0.015	0.002	0.000	-0.015	0.002	0.000	-0.015	0.002	0.000
Woman's education (None)	Primary							-0.303	0.054	0.000	-0.304	0.054	0.000	-0.302	0.054	0.000
	Secondary +							-0.453	0.066	0.000	-0.452	0.066	0.000	-0.451	0.065	0.000
Number of daughters (None)	One or more							-0.034	0.043	0.430	-0.035	0.043	0.414	-0.035	0.043	0.415
Woman's religion (Muslim)	Christian							-0.701	0.064	0.000	-0.702	0.064	0.000	-0.674	0.062	0.000
	Other/none							-0.005	0.105	0.959	-0.005	0.105	0.961	0.015	0.105	0.885
FGC status (No FGC)	FGC							2.169	0.081	0.000	2.168	0.081	0.000	2.132	0.068	0.000
Exposure to mass media (None)	Infrequent							-0.237	0.051	0.000	-0.237	0.050	0.000	-0.234	0.051	0.000
	Frequent							-0.274	0.048	0.000	-0.274	0.048	0.000	-0.265	0.047	0.000
No. of HH decisions wife involved in (0-5)								-0.025	0.014	0.075	-0.025	0.014	0.077	-0.023	0.014	0.092
No. of IPV justifications wife agrees with (0-5)								0.129	0.010	0.000	0.129	0.010	0.000	0.128	0.010	0.000
No. of controlling behaviours wife experiences (0-5)								0.000	0.015	0.975	-0.006	0.015	0.706	-0.006	0.015	0.716
Contextual variables																
FGC prevalence in ethnic group (%)								0.017	0.003	0.000	0.017	0.003	0.000	0.018	0.003	0.000
Years since FGC became illegal														-0.122	0.028	0.000
Random Part																
Level 2 variance		2.460	0.449		2.444	0.447		0.566	0.116		0.568	0.116		0.570	0.116	
ICC (%)		42.8			42.6			14.7			14.7			14.8		
MOR		1.490			1.485			0.715			0.716			0.717		
PCV (%)		ref			0.7			76.8			-0.4			-0.4		
Level 3 variance		0.485	0.418		0.499	0.424		1.057	0.647		1.056	0.647		0.215	0.159	
ICC (%)		7.8			6.8			21.5			21.5			5.3		
MOR		0.662			0.613			0.977			0.976			0.440		
PCV (%)		ref			14.2			-154.1			0.1			79.6		

Level 1: n 31,067, Level 2: n73, Level 3: n6. Reference group for categorical variables is shown in brackets.

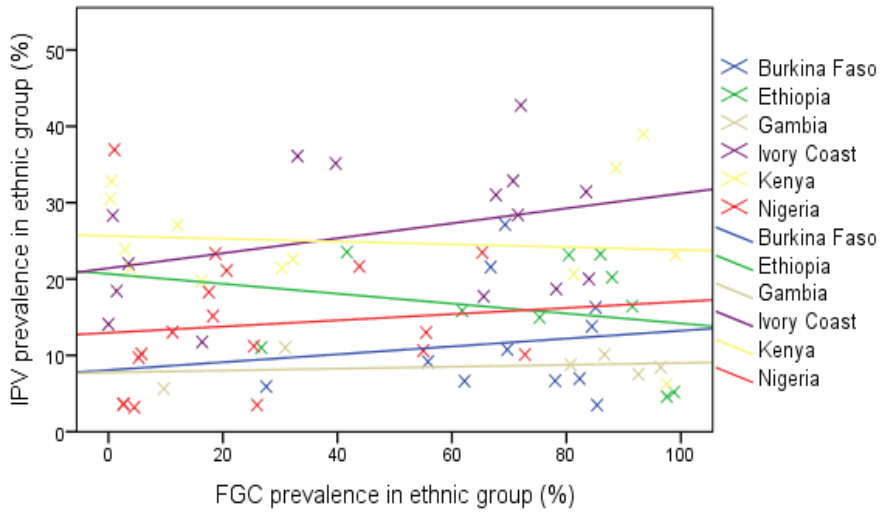
ICC: Intra-class correlation (proportion of the variation found at that level), MOR: median odds ratio (expresses community variance on an odds scale) PCV (proportional change in variance)

Model 1: Null Model, Model 2: + IPV experience, Model 3: Controlling variables excluding IPV experience, Model 4: + IPV experience, Model 5 + Level 3 contextual variable

8.3 RESULTS

IPV prevalence is not significantly correlated with FGC prevalence at the ethnic group level, either overall (r=-0.031, p=0.794 n73), or in any of the study countries (illustrated in Figure 8.2, full results in Appendix Table 8.1). A wide range of IPV prevalence is found at all levels of FGC prevalence, and notably even in ethnic groups with close to no FGC, IPV prevalence ranges from 4-37%.

Figure 8.2: Prevalence of IPV and FGC by ethnic group and country



Hypothesis 1: Women with FGC have a higher risk of experiencing IPV

Overall 12.7% of women experienced IPV in the prior year, and on average slightly fewer women with FGC experienced IPV (12.4% compared to 13.1%), illustrated by country in Figure 8.3. Descriptive analysis is shown in Appendix Table 8.2. There is a higher IPV prevalence overall in Ethiopia, Kenya and Ivory Coast, but there is no common pattern found in these six countries in relation to FGC status. A higher proportion of women with FGC experienced IPV in the Gambia, Nigeria and notably Ivory Coast, whereas in Ethiopia and Burkina Faso a higher proportion of women without FGC experienced IPV, and in Kenya there is no difference by FGC status.

Single level multivariate logistic regression analyses by country tested the effect of FGC status while controlling for confounding factors. The association between FGC status and IPV experience was only found to be significant and positive in Ivory Coast (OR 1.27, 95%CI 1.01-1.59, p=0.043). In Ethiopia, Gambia, Kenya and Nigeria the association was positive but not at significant levels, and in Burkina Faso the association was negative, but not at a statistically significant level. Full results of single level analyses are provided in Appendix Table 8.4.

The results of the multilevel models using pooled data from all six countries (Table 8.2) show that FGC status has a small and not statistically significant positive association with IPV experience when control variables were included in the models. The null Model 1 shows that most of the variation in IPV experience is at the individual level (84.9%), with little variance between ethnic groups (9.5%) or between countries (5.6%). Model 2 shows that without any control variables FGC status has a positive and significant association with IPV experience (OR 1.15, 95%CI 1.05-1.27, p=0.003), although the inclusion of FGC status has little effect on the overall model and increases the Level 2 and Level 3 variance slightly.

Model 3 controls for variables which have been shown in previous studies to affect women's risk of experiencing IPV; wealth reduces the risk of IPV but only significantly so in the richest households (OR 0.74, 95%CI 0.63-0.87, p<0.000); women whose husbands drink alcohol and who are polygamous marriages have a significantly higher risk of experiencing IPV (OR 1.27, 95%CI 1.01-1.59, p=0.043 and OR 1.20, 95%CI 1.09-1.32, p<0.000). Childhood exposure to IPV also increases the odds of experiencing IPV (OR 2.10, 95%CI 1.92-2.30, p<0.000), and experience of more spousal controlling behaviours also significantly increases the odds of experiencing IPV (OR 1.70, 95%CI 1.66-1.75, p<0.000). The other individual level control variables (household location, woman's age, woman's education, and the number of household decisions the woman is involved in) did not have a significant association with IPV experience in this model. Likewise, the men's attitude towards IPV the ethnic group, included as a level 2 contextual variable, is not significantly associated with IPV experience (OR 1.15, 95%CI 0.93-1.43, p=0.200). Together the control variables reduce the level 2 variance from 0.354 to 0.217 (38.5%) and the level 3 variance from 0.215 to 0.082 (63.7%).

Model 4 adds FGC status to the control model, and the results show that having undergone FGC has a positive but small association with IPV experience and is not a statistically significant (OR 1.10, 95%CI 0.92-1.20, p=0.067). Adding FGC status has a negligible effect on the level 2 or level 3 variance and does not alter the effect of the control variables in the model.

Hypothesis 2: Experiencing IPV increases women's support for FGC

Three quarters of women in the study sample (76.7%) do not support the continuation of FGC. FGC support does not vary greatly by IPV experience; support is slightly lower among women who had experienced IPV (21.5% compared to 23.6%), illustrated by country in Figure 8.4. Full descriptives are provided in Appendix Table 8.3. In The Gambia, where FGC was legal at the time of survey, support for FGC is markedly higher compared to the other five countries. There is no common pattern

between IPV experience and FGC, in half the countries more women who experienced IPV support FGC, whereas the opposite is found in the other half.

Figure 8.3 Women's IPV experience by FGC status

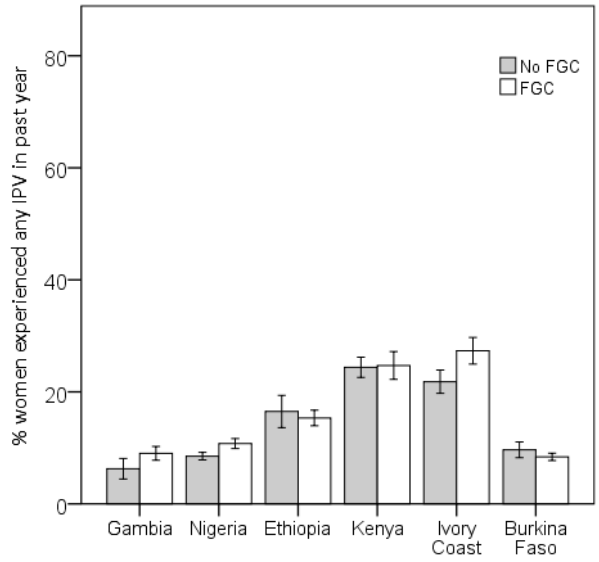
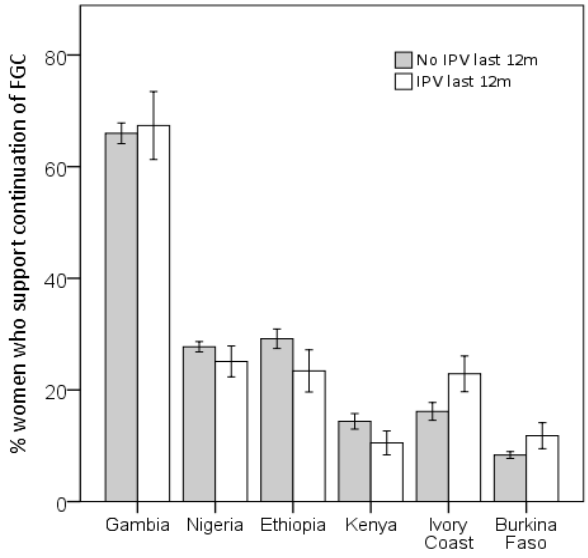


Figure 8.4 Women's support for FGC by IPV experience



Note: Error bars show 95% CI

The single level logistic regression models by country show that IPV experience is significantly associated with supporting FGC in Burkina Faso (OR 1.47, 95%CI 1.14-1.89, p=0.003) and Ivory Coast (OR 1.43, 95%CI 1.11-1.86, p=0.007). However, the opposite is found in Ethiopia (OR 0.73, 95%CI 0.56-0.94, p=0.017) and the Gambia (OR 0.67, 95%CI 0.46-0.99, p=0.044) where women who experienced IPV have higher odds of stating that FGC should not be continued. In Nigeria and Kenya, IPV experience is not significantly associated with FGC support. Full results of single level analyses are shown in Appendix Table 8.5.

The multilevel models with pooled data from all six countries (Table 8.3) demonstrate that when variables known to affect women's support of FGC are controlled for, IPV experience is not significantly associated with women's support for FGC. The null Model 1 shows that a large element of variance in FGC support is at the ethnic group level (42.8%) with 7.8% at the country level, and 49.4% at the individual level. Model 2 shows that IPV experience alone does increase the odds of a woman supporting the continuation of FGC (OR 1.18, 95%CI 1.07-1.31, p=0.001). Although this association is statistically significant, the addition of IPV experience to the model makes very little difference to the level 2 or level 3 variance compared to Model 1 (the proportional change in variation is only 0.7% and 14.4% respectively).

Model 3 shows the effect of controlling for variables known to be important predictors of FGC support, most which have the anticipated effect on women's support for FGC. A woman's own FGC status is the strongest predictor of supporting FGC (OR 8.75, 95%CI 7.47-10.26, p<0.000), and women who agree with IPV justifications are also more likely to state support for FGC (OR 1.14, 95%CI 1.12-1.16, p<0.000). Other variables which reduce the probability of women supporting FGC are greater household wealth (OR 0.60, 95%CI0.51-0.70, p<0.000), older age (OR 0.99, 95%CI 0.98-0.99, p<0.000) having either primary or secondary education, being Muslim rather than Christian (OR 0.50, 95%CI 0.44-0.56, p<0.000) and having any exposure to mass media. In this sample, household location, whether the woman has any daughters, and whether the woman is involved in any household decisions, are not significantly associated with a woman's FGC support. FGC prevalence in the woman's ethnic group, a level 2 contextual variable, also has a significant association; the odds of supporting FGC increases significantly as FGC prevalence increases (OR 1.02, 95%CI 1.01-1.02, p<0.000). The addition of the control variables reduces the level 2 variance substantially, with a 78.8% PCV, whereas they result in a 154% increase in level 3 variance.

The results of Model 4 show that when IPV experience is not significantly associated with FGC support in the full model (OR 1.08, 95%CI 0.97-1.21 p=0.166). The addition of IPV experience to the model makes a negligible impact on the level 2 or 3 variance, or on the effect of the control variables. Model 5 includes the number of years since FGC was made illegal as a level 3 contextual variable which has a large impact on the level 3 variance, reducing it by 79.6%. However, its inclusion does not alter the size of the association or significance of any of the individual level variables, including IPV experience.

8.4 DISCUSSION

In this study two research gaps concerning the relationship between FGC status or support, and IPV experience, were addressed using multilevel models and data from 6 countries in sub-Saharan Africa (UN Women, 2017b). The results do not show an association between the two behaviours.

The first analysis tested whether women with FGC are more susceptible to IPV experience. The multilevel logistic regression analysis results (Table 8.2, Model 4) do not support this hypothesis. Women with FGC have a very slightly higher, but not statistically significant, odds of experiencing IPV and the effect of FGC status on the model variance is negligible. Other factors are of much greater importance in understanding women's IPV experience, including their husband's alcohol use, their exposure to IPV in childhood, being in a polygamous marriage, living in poorer households and experiencing controlling behaviours by their husband.

The multilevel model only controls for a small number of potentially confounding variables (and only explains a small proportion of the individual level variance). Numerous other factors which have been demonstrated to affect the incidence of IPV are not included here, for example those relating to the husband/partner's profile (for example husband's exposure to childhood violence, involvement in community violence, and gender attitudes (Chirwa et al., 2018;Fleming et al., 2015)) and relating to the couple dynamics (for example extra-marital sexual activity, and marital conflict (Jewkes et al., 2017)). It is likely that the association with FGC status would be further reduced if data for these other relevant factors were available for inclusion.

This result conflicts with previous studies which found that women with FGC do have significantly higher odds of experiencing some form of IPV, in the Ivory Coast, Mali, Egypt and Kenya (Peltzer and Pengpid, 2014;Salihu et al., 2012;Refaat et al., 2001;Ramage, 2018). Of these countries, Kenya and Ivory Coast are represented in this study, using the same DHS datasets. The Ivory Coast positive association is replicated in the single level logistic regression results (Salihu et al., 2012) (Appendix Table 8.4), but for Kenya the reverse result was obtained. The difference is explained by the different variables used in the models, as the Kenya study did not control for husband's alcohol use or the wife's exposure to IPV in childhood, and the IPV outcome was a lifetime indicator which included emotional as well as physical and sexual IPV (Refaat et al., 2001). The results here demonstrate the value of multilevel models which allow for data from multiple countries to be pooled, while recognising the hierarchical structure of the data. The results do not support a generalised statement that FGC status is associated with an increased risk of experiencing IPV.

This null results challenges both the individual (revictimisation) and societal (patriarchal) theoretical bases for anticipating that FGC and IPV may be associated. Although revictimisation relating to other forms of VAWG experienced in childhood has been demonstrated e.g. (Classen et al., 2005) to my knowledge no studies have considered FGC in childhood from this perspective. It is unknown whether FGC would result in the same psychological trauma as other forms of VAWG experienced in childhood. FGC has been shown to cause psychological trauma, however studies have examined trauma resulting from first sexual or obstetric experiences, rather than trauma as a result of undergoing the FGC procedure (Mulongo et al., 2014;Berg and Underland, 2013). And conversely, FGC can be a positive event and source of pride for some girls and women, and women with FGC may have higher status in the societies in which FGC is practised (Shell-Duncan, 2004;Battle et al., 2017). Therefore, FGC may not cause the same psychological sequelae (e.g. alcohol use, drug abuse, sexual risk-taking) that are associated with other forms of adverse childhood experiences, which may explain the null result found here.

This result also challenges the assertion that FGC and IPV are explained by the same societal root cause (UN Women, 2017b). The role of the patriarchy in the maintenance of either of these behaviours has not been empirically demonstrated, and there is counter evidence that challenges whether FGC is maintained by patriarchal values and gender inequality, or that it is driven by a desire to control women (Howard and Gibson, 2019). Patriarchal explanations are also lacking as they do not explain at an individual level why men would behave violently in several ways towards their wives. In contrast to the broad literature on women's multiple experiences of VAWG, 'poly-perpetration' by men has been little studied. In the case of FGC and IPV specifically, neither theory for co-occurrence adequately explains why men married to women with FGC might be more likely to be violent towards them, or alternatively, why men who perpetrate IPV might be more likely to marry a woman with FGC.

The second analysis tested whether women's IPV experience is associated with their support for FGC continuation. The single level analyses showed that the relationship between IPV experience and women's stated FGC support varies by country, but the multilevel model with pooled data from all six countries (Table 8.3, Model 4) showed that the association with IPV experience is small and not statistically significant. The other variables controlled for in the model, such as the mother's FGC status and FGC prevalence in the ethnic group, are most strongly significantly associated with FGC support.

This null finding challenges the expectation that women who experience IPV will be more likely to support FGC (UN Women, 2017b). The theoretical basis for this expectation is not explained, but it seems to assume both that IPV experience affects women's autonomy, and that women's autonomy is related to their FGC support. These assumptions are based on a patriarchal interpretation of FGC, posing men as the proponents of FGC and women as the opposers, anticipating that women who experience IPV will have lowered resistance to oppose FGC. The reverse could be equally possible, whereby women with higher autonomy may support FGC (UNICEF, 2013). The intricacies of FGC support and decision-making regarding daughters' FGC procedures are poorly understood (Kaplan et al., 2013b). However, the assumption that greater autonomy for women would necessarily lead to lower support for FGC needs further evidence and theoretical grounding.

8.4.1 Differences between IPV experience and FGC support

In addition to finding no statistical association between FGC and IPV, the results also reveal several differences between the two behaviours. Firstly, community level factors appear to be less important in determining IPV experience than maintaining FGC support. This is unsurprising given

the highly enculturated nature of FGC. This is evident from two aspects of the results. Firstly IPV experience is relatively uniform across ethnic groups (ranging from 0-35%) compared to the much greater variation seen in FGC support (ranging from 0-99%) (illustrated in Figure 8.2).Secondly the multilevel model results show that the variance between ethnic groups (and to a lesser extent between countries) is much greater in the model examining FGC support ((B 2.460 SE 0.449, 42.8% ICC in the null model) than in the model testing IPV experience ((B 0.354 SE 0.070), 9.5% ICC in the null model).

The behaviours and beliefs among members of the ethnic groups appear to be more important determinants of FGC support than of IPV experience. The FGC support model included ethnic group FGC prevalence as a level 2 contextual variable which was shown to be positively and significantly associated with women's support of FGC. The IPV experience model included men's IPV justifications in the ethnic group, but the results show that living in an ethnic group in which men agreed with a greater number of IPV justifications did not increase the odds of a woman experiencing IPV. In this model IPV behaviour is better predicted by individual level variables. This finding contrasts with the prevailing view of IPV adopted by the WHO which suggests that social norms concerning IPV acceptability within the community are important determinants of IPV risk (WHO/LSHTM, 2010).

Secondly, explaining women's risk of experiencing IPV appears to be more elusive than explaining their FGC support. The small number of control variables included in the FGC support model explain a large amount of the variance (reducing the ethnic group variance by 77% in Model 5 compared to Model 1). By contrast, the variables used in the IPV experience model only reduce the ethnic group variance by 40% from Model 1 to Model 4. This suggests that many further variables are required to fully understand women's risk of IPV.

Finally, the results also show that different predictor variables are significantly associated with IPV experience and FGC support. Women's age and education are not significantly associated with IPV experience, nor is household wealth or household location. However, all four of these variables are associated with FGC support. The variables most strongly related to IPV experience are male characteristics; whether the husband has more than one wife, whether he drinks alcohol, whether he exerts controlling behaviours over his wife, and whether the wife's father beat her mother. By contrast male factors are largely absent from the FGC support model and the key explanatory variable is the mother's own FGC status.

8.4.2 Study Limitations and further research

The use of cross-sectional data means that a temporal relationship between the variables cannot be established. This temporal relationship is likely to be particularly key for understanding causes and consequences of women's IPV experience. For example, longitudinal data that captures women's FGC support or decision regarding their daughters' FGC procedure before and after any IPV experience would improve understanding of whether IPV experience is associated with FGC behaviour. The need for ethnographic studies to fill these gaps are discussed in Section 9.6.6.

Another limitation relates to the use of secondary datasets as the survey questions are not tailored to these specific research questions. Here all available relevant DHS variables were used, but more nuanced data would be revealing. For example, whether men who marry women with FGC have different attitudes about gender equality or IPV acceptability. In relation to women's support for FGC it would be informative to have a better understanding of how the decision to have FGC performed on any daughters is made, for example whether women's autonomy influences this decision, and if so, in which direction (Kaplan et al., 2013a).

Finally, here data from only six out of the possible thirteen countries were suitable for analysis. As shown in Figure 8.1, the range of FGC and IPV prevalence across all thirteen countries varies. The results might differ if data from all thirteen countries (or even all 29 countries in which FGC is commonly practised) were suitable for inclusion.

8.5 CONCLUSION

In this paper the association between FGC and IPV were examined, to address the research gaps identified by the UN Women paper 'Finding convergence in policy frameworks' using data from 6 countries in sub-Saharan Africa (UN Women, 2017a). Two models were run, testing firstly whether women who have undergone FGC are more susceptible to IPV, and secondly whether women's experience of IPV affects their support of FGC. The results do not support either hypothesis, and there is no evidence of an association between FGC and IPV.

These results have important implications for policy and programme work. The lack of a demonstrable association between FGC and IPV suggests that it is unlikely that there will be a knock-on effect from programmes aimed at either behaviour; reducing levels of FGC will not affect IPV prevalence, and vice versa. The results also highlight the potential problems that can result from grouping disparate behaviours together under one acronym, such as VAWG, as important differences may be overlooked. Even the acronyms FGC or IPV include sub-types of behaviours

which may be more effectively tackled separately and in a context-specific manner (Fulu et al., 2013;Berg and Denison, 2012b).

The clear difference in profile and risk factors between IPV and FGC challenges the value of implementing coordinated programmes to address both behaviours simultaneously. The results suggest that it will be more effective to create a targeted programme tailored to the specific risk factors involved in either IPV or FGC, taking the local context into account.

CHAPTER 9 DISCUSSION

This thesis presents an exploration of the drivers behind two harmful practices identified for eradication by the United Nation's Sustainable Development Goals: female genital cutting (FGC) and intimate partner violence (IPV). The overall objective of this thesis is to identify reasons for their persistence and reveal previously unrecognised drivers by examining their ultimate and proximate causes. This continues the anthropological tradition of examining cross-cultural practices with scientific objectivity, emphasising the importance of understanding a behaviour within its context, here using an evolutionary anthropological approach. Demographic Health Survey (DHS) datasets from countries in sub-Saharan Africa were used to test the research questions.

In this chapter the findings from the four research chapters are summarised, and their implications are discussed in relation to the research objectives; to further understanding of the drivers behind IPV perpetration and the persistence of FGC; to understand the extent to which evolutionary theory can be used to explain IPV and FGC; and, to draw out implications from the findings which could be relevant to policy work targeting the elimination of either practice. The limitations of the research are discussed, and unanswered questions and areas for future research are considered.

9.1 SUMMARY OF FINDINGS

Chapters 5 and 6 tested whether evolutionary motives might be associated with FGC persistence, and FGC related behaviours of the different parties involved. In most contexts the decision to undergo FGC is made by the parents rather than the girl herself (Kaplan et al., 2013a;Sabahelzain et al., 2019), and therefore the parents' evolutionary motivations are under examination (Hamilton, 1964). Parents' decisions will be affected by many factors, such as marriage opportunities and community influence, which are tested in these chapters.

Chapter 5 examined whether marriage to women with FGC might enhance men's paternity certainty, and accordingly, whether FGC status is associated with women's marriage opportunities. It is proposed that FGC may be enforced indirectly by marriage preferences for men, influencing parents to have their daughters cut to ensure their marriageability. The proposal that paternity certainty theory can explain the persistence of FGC was tested in contemporary populations in West Africa. The results showed that being cut does not reduce most measures of women's extra-pair sexual activity, irrespective of FGC type, although women with FGC were found to have significantly lower odds of having more than one lifetime sexual partner. Women with FGC got married at a younger age which is indicative that FGC status affects marriage opportunities, interpreting marriage at a

younger age as a demonstration of preference. Additionally, in communities where the perceived paternity risk may be higher, men showed a greater preference for marrying a wife with FGC. Together, the results indicate that, although FGC may not be a reliable signal of greater paternity confidence, concern about paternity may be one of several factors contributing to the persistence of FGC.

Chapter 6 set out a more direct examination of the fitness consequences resulting from the parental decision to have FGC performed on their daughter. This study examined the social transmission mechanisms for FGC and found that the frequency of FGC within a girl's ethnic group had a strong association with whether she was cut, controlling for the mother's FGC status and other confounding factors. The study also tested the interaction of a woman's FGC status and the FGC prevalence in her ethnic group and found that the observed frequency-dependent effect had evolutionary fitness benefits, measured by the women's number of surviving offspring. Women aligned with the FGC norm for their community (whether that norm is undergoing FGC or not) had higher reproductive success than women with the less prevalent FGC status. These findings are novel as they provide empirical evidence of a social learning mechanism that is also adaptive in evolutionary fitness terms. This study demonstrates the benefit of using an evolutionary approach to understand the persistence of behaviours which are detrimental to health and well-being.

Chapter 7 examined evolutionary motivations for male IPV perpetration. Men and women's conflicting evolutionary priorities might result in men perpetrating IPV in certain circumstances (Stieglitz et al., 2011;Buss and Duntley, 2011;Miller et al., 2010). Three proposals for IPV based on a sexual conflict framework were tested in this study, examining physical IPV and sexual IPV separately: firstly, that men may use IPV to protect their paternity in response to their wives' actual or perceived risk of extra-pair sex (paternity concern); secondly, that men may use IPV to coerce their wives to have more children (reproductive coercion); and thirdly, that women's objection to their husbands pursuing reproductive opportunities outside the marriage could result in IPV (paternal disinvestment). The results showed no association between indicators of reproductive coercion and either IPV type, however indicators of paternity concern increased the risk of both physical and sexual IPV, and indicators of paternal disinvestment increased the risk of physical IPV only. Some risk factors identified (e.g. husband or wife's infidelity) correspond with IPV risk factors identified in non-evolutionary studies, however an evolutionary approach provides an explanation as to why these particular factors may precipitate conflict.

Chapter 8 examined whether there is an association between IPV and FGC, two forms of violence against women and girls (VAWG). The UN Women have recently advocated strengthening the policy

linkages between IPV and FGC (UN Women, 2017a). Associations between other forms of VAWG have been demonstrated in literature, which are proposed to be due either to societal factors such as gender inequality and patriarchal values or individual factors relating to re-victimisation (Heise, 2012;Kidman, 2017;Krebs et al., 2011). The results did not show an association between IPV and FGC in this sample. Women with FGC were not more susceptible to experiencing IPV, and women who had experienced IPV were not more likely to state their support for the continuation of FGC. Additionally, the importance of individual and community factors varied for either outcome; ethnic group characteristics were associated with FGC support, while IPV was more strongly associated with individual level factors. These results have important policy implications and suggest that grouping FGC and IPV interventions together needs further evidence.

The analysis and results from each chapter are summarised in Table 9.1 and a more detailed summary of the variables and DHS countries used in each analysis are included in Appendix 9.1.

Table 9.1 Summary of findings

	CHAPTER	HYPOTHESES	OUTCOME OF INTEREST	PREDICTOR OF INTEREST	RESULT
5	Is there a link between paternity concern and female genital cutting in West Africa?	1) Women with FGC are less likely to have extra-pair sex	6 different indicators of extra-pair sex	FGC status	Women with FGC have higher odds of having had 2 or more lifetime sexual partners. No association with other 5 extra-marital sex indicators
		2) Women with FGC marry earlier than women without FGC	Age at first marriage	FGC status	Women with FGC have higher odds of marrying at a younger age.
		3) Men with high paternity concern are more likely to marry a first wife with FGC	FGC status of man's first wife	Individual and group proxy indicators for paternity concern	Individual level proxies did not show an association. Prevalence of premarital sex, extramarital sex and average number of sexual partners among men and women in ethnic group all increased odds of first wife with FGC.
6	Frequency-dependent female genital cutting behaviour confers evolutionary fitness benefits	1) FGC is a frequency-dependent behaviour	One or more daughters with FGC	FGC frequency in mother's ethnic group	FGC frequency in mother's ethnic group significantly associated with having daughters with FGC, controlling for mother's own FGC status.
		2) Fitness benefits associated with frequency-dependent FGC behaviour	Number of surviving offspring at 40 years	Interaction between mother's FGC status and FGC frequency in mother's ethnic group	Cross level interaction between mother's FGC status and ethnic FGC prevalence has significant effect on number of surviving offspring.
7	Can evolutionary sexual conflict help to explain patterns of male-to-female IPV?	1) Men exposed to indicators of paternity concern will have higher odds of perpetrating IPPV and IPSV	IPPV and IPSV in the last 12 months	Individual and group proxy indicators for paternity concern	Wife's but not husband's sexual activity is predictive of IPPV and IPSV. Group proxy indicators not associated with either IPPV or IPSV.
		2) Men whose reproductive interests' conflict with their wives' will have higher odds of perpetrating IPPV and IPSV	IPPV and IPSV in the last 12 months	Conflicting fertility desires, indicators of 'paternal disinvestment'	Conflicting fertility desires have weak association in contrasting direction with IPPV and IPSV. Indicators of paternal disinvestment associated with IPPV but not IPSV.
8	Testing the association between FGC and IPV in six countries in sub-Saharan Africa	1) Women with FGC have a higher risk of experiencing IPV	IPV experience in last year	FGC status	No association found.
		2) Experiencing IPV increases women's support for FGC	Stated support for FGC continuation	IPV experience in last year	No association found.

9.2 IMPLICATIONS RELEVANT TO THE PERSISTENCE OF IPV AND FGC PERPETRATION

The findings which contribute new understanding to the perpetration of IPV and FGC are described in this section. The implications of these findings for evolutionary anthropology are discussed in Section 9.3, and the implications for policy work are discussed in Section 9.4. Outstanding questions and areas for future research relating to these findings are discussed in further detail in Section 9.6.

9.2.1 Drivers behind the persistence of Female Genital Cutting

9.2.1.1 Parents' FGC decision is associated with the FGC prevalence in their community

The results reveal that FGC behaviour is transmitted via frequency-dependent social learning mechanisms (Chapter 6). When determining whether to have their daughters cut, it appears that parents are influenced by how common FGC is within their ethnic group.

While this may seem intuitive, until recently this was thought to be an individual or parental decision, and likewise, alternative social learning mechanisms have been proposed such as prestige bias (Henrich and Gil-White, 2001;Ross et al., 2016). Frequency-dependent learning biases for FGC have been suggested by modelling (Ross et al., 2016), and addressed by two empirical studies, however methodological issues with these studies challenged the validity of the findings, as discussed in Section 3.2.4 (Hayford, 2005;Ross et al., 2015). The approach taken in this study varies with the existing studies in two ways. Importantly, the models used in this study controlled for the mother's FGC status, and controlling for this vertical form of FGC transmission frequency-dependent horizontal transmission of FGC behaviour is revealed. The reference group used for social transmission in this study was ethnic group, rather than DHS cluster, which is a meaningful reference group for FGC behaviour (Gruenbaum, 2005;Ross et al., 2016;Yoder and Wang, 2013;Abusharaf, 2001;Pemunta, 2012;Kaplan et al., 2013b). A further strength of this study was that frequency-dependent FGC transmission was tested in numerous countries; all the available DHS countries that met the selection criteria were used in the analysis, and frequency-dependent transmission of FGC behaviour was demonstrated in all five study countries in single and multilevel modelling.

Novel findings from this study also concern the interaction between the mother's FGC status and FGC frequency in her community which was not addressed in previous studies (Hayford, 2005;Ross et al., 2015). A mother's FGC status is the strongest predictor of girl undergoing FGC, however the results show that mothers do not necessarily replicate their own status on their daughters. Women with FGC living in an ethnic group where FGC is uncommon have a lower probability of having a cut daughter than women with FGC living in an ethnic group where FGC is common, indicating that they are responsive to local pressures. By contrast women without FGC appear to be unlikely to have

their daughters cut, irrespective of context. This latter finding is contrary to predictions associated with frequency-dependent transmission and suggests that other forces may be acting on FGC behaviour (Efferson et al., 2008;Boyd and Richerson, 1985). This also suggests that once the behaviour is abandoned it may not be resumed, which has implications for eradication policy discussed in Section 9.4.1.1.

The interaction between a mother's own FGC status and the FGC prevalence in her community is relevant to understanding FGC behaviour when individuals are exposed to different FGC prevalences, for example through migration of marriage. Diaspora communities from FGC practising communities living in countries where FGC is not practised have been found to change their attitudes towards FGC (Morison et al., 2004;Johnsdotter et al., 2009;Gele et al., 2012). This attitudinal change is likely to be due to many factors but being exposed to a different FGC frequency may be influential.

9.2.1.2 FGC enhances women's reproductive success in certain contexts

Women with FGC are shown to have higher reproductive success than women without FGC, as measured by the number of surviving offspring at age 40, but only in ethnic groups in which FGC is the most prevalent behaviour (Chapter 6). These results confirm the predictions made by human behavioural ecology, and show that parents are optimising their fitness by flexibly altering their behaviour in response to environmental conditions (Laland and Brown, 2011). This is the first study to demonstrate the fitness consequences associated with a frequency-dependent socially transmitted behaviour (Wander, 2017). This finding provides an ultimate explanation for why FGC, the behaviour of interest, is perpetuated in certain contexts. However, it also provides an ultimate explanation for why FGC is not performed in contexts where FGC prevalence is low. This frequency-dependent fitness optimising effect was demonstrated all five study countries, in both single and multilevel analysis.

These results indicate that the parents of women in communities where FGC is prevalent (who made the decision for them to undergo FGC) will have higher inclusive fitness (Hamilton, 1964). For parents with multiple daughters the effect on their inclusive fitness will be multiplied. Likewise, men married to women with FGC are also likely to have higher fitness, an effect that could be amplified for men married polygamously. Higher marital fitness rather than concern about paternity may be an additional evolutionary driver for men's marital preferences for women with FGC. This is discussed in Section 9.6.3.

As well as revealing evolutionary drivers behind the persistence of FGC, these results also contribute to understanding to why FGC behaviour may be resistant to change. The context needs to change in order for individual behaviour to change. This is discussed further in Section 9.4.1.

9.2.1.3 FGC does not meet the assumptions of costly signalling

A number of scholars have proposed that FGC may function as costly signalling, and that FGC is either a demonstration of genetic quality or a signal of sexual fidelity and paternity certainty to potential mates (Wilson, 2008;Ross et al., 2016;Power, 2015). Grafen's theory sets out three main assumptions for costly signally to apply (discussed in Section 2.3.3), however, the results from Chapter 6 show that FGC does not meet these assumptions, even if male mate choice is operating (Grafen, 1990;Zahavi, 1975;Brown et al., 2009b). Firstly FGC is not necessarily costly and is shown to increase fitness in certain circumstances (demonstrated in Chapter 6), secondly having undergone FGC is not a reliable indicator of genetic condition (as demonstrated in supplementary analysis for Chapter 6, Appendix Table 6.4) or a reliable indicator of sexual fidelity (demonstrated in Chapter 5), and thirdly FGC is not visible to potential mates. The hidden nature of FGC and the potential for 'cheating' are discussed in Section 9.6.2. Further, in contexts where FGC is almost universal, FGC status would not be a differentiator for mate choice to operate.

9.2.1.4 FGC status impacts on women's marriage opportunities

Marriageability is presented as one of the primary reasons for FGC, both by theorists and many practising communities (UNICEF, 2010;Mackie and LeJeune, 2009;Berg and Denison, 2013;Gruenbaum, 2001b;Ross et al., 2016). However qualitative and quantitative studies have found mixed results (Adongo et al., 1998;Missailidis and Gebre-Medhin, 2000;Abathun et al., 2016;Almroth et al., 2001a;Sakeah et al., 2006;Gele et al., 2013;Reason, 2004;Okonofua et al., 2002;Van Rossem and Gage, 2009;Wagner, 2015). The results of Chapter 5 found that FGC status does affect women's marriage opportunities in this sample in two ways. Women with FGC have higher odds of getting married at a younger age. Further, in contexts where extra-pair sex is more prevalent and paternity may be more of a concern, men have higher odds of marrying a first wife with FGC. This suggests that marriage preferences for men may contribute towards the persistence of FGC, through the combined evolutionary interests of male paternity concern and parental inclusive fitness.

9.2.2 Drivers behind Intimate Partner Violence perpetration

9.2.2.1 Different risk factors are associated with physical and sexual IPV

The results suggest that physical IPV (IPPV) and sexual IPV (IPSV) may be triggered by different motivating factors. The results show that fewer of the control variables are significantly associated with IPSV than IPPV, notably childhood exposure to IPV, husband's education, husband's age and household location are not significantly associated with IPSV and husband's alcohol use has a smaller (although still significant) association with an increased risk of IPSV. Similarly, fewer of the experimental variables are associated with IPSV and, where they are, the effect sizes and significance are lower than with IPPV. Some unusual anomalies are shown, for example women who are in employment are shown to be at higher risk of IPSV but not IPPV. Further research is required to understand risk factors for IPSV.

9.2.2.2 Evidence that IPV perpetration is motivated by optimising reproductive success is mixed

Proxies designed to test for different evolutionary motivations for IPPV and IPSV were examined in Chapter 7, using an evolutionary sexual conflict framework. This proposes that conflict, and potentially IPV, may arise where men's fitness goals differ from their wives'. Men are shown to be more likely to perpetrate both physical and sexual IPV when their wives have had more sexual partners. Men may be reacting to their risk of non-paternity, and using IPV to reduce this risk, thus enhancing their reproductive success. There is also evidence that reproductive conflict in a marriage is associated with IPV. Conflict, potentially leading to IPV may arise when men are 'disinvesting' from the marriage and seeking reproductive opportunities elsewhere, against their wives' wishes. Proxy indicators of paternal disinvestment, including polygamy, men's extra-pair sex and men having other children outside the marriage, are found to be associated with IPPV perpetration. In both analyses, the impact on fitness resulting from men's IPV perpetration cannot be tested, instead fitness impacts are inferred from proxy indicators. The limitations associated with the use of proxies is discussed in Section 9.5.

9.2.2.3 Individual rather than community factors predict IPV perpetration in this sample

Community factors and social norms within a community have been demonstrated to be important determinants of IPV occurrence in a number of studies (Usdin et al., 2005;Manji, 2018;Clark et al., 2018;Alexander-Scott et al., 2016;Heise and Manji, 2016;Jewkes et al., 2015). However, the research findings from both Chapter 7 and 8 which analysed IPV occurrence did not find that community level factors included in the multilevel models were associated with IPV perpetration. Ethnic group indicators of extra-pair sexual activity were included in the models testing paternity concern in

Chapter 7, and the attitude towards IPV by men in the ethnic group were included in the models testing for an association with FGC status in Chapter 8. The results of both studies showed that individual level male factors, such as low wealth, alcohol use, younger age and lower levels of education, are much more important than group factors in predicting IPV occurrence. The contrast of this result with the findings of other studies warrants further investigation.

9.3 IMPLICATIONS RELEVANT TO EVOLUTIONARY ANTHROPOLOGY APPROACH

In this section, insights gained from applying an evolutionary approach to understanding the persistence of IPV and FGC are discussed. The findings from Chapters 5, 6 and 7 (discussed in Sections 9.2.1 and 9.2.2) demonstrate how IPV and FGC may confer evolutionary fitness benefits to the perpetrators in certain contexts despite the cost to health and well-being for the victims and perpetrators. This finding relating to a fitness effect is stronger for FGC than IPV. The insights gained confirm the validity of applying evolutionary anthropological theory to testing human behaviours and suggest that, with careful contextual analysis of the fitness costs and benefits, new understanding of behavioural motivations may be uncovered (Mattison and Sear, 2016). Additionally, the findings make several other contributions to the evolutionary anthropology literature.

9.3.1 Interaction between cultural evolution and Darwinian evolution

The frequency-dependent fitness optimising results found in Chapter 6 integrates ideas from cultural evolution and human behavioural ecology to identify how and why fitness may vary according to local context (Nettle et al., 2013;Laland and Brown, 2011;Mesoudi, 2011b). The interaction between cultural evolution and Darwinian evolution is an area that has been subject to much theorising and modelling but has been largely unexplored in the empirical literature (Mace, 2014;Boyd et al., 2011) (discussed in Section 2.4.2). Testing their interaction empirically using data from contemporary populations provides a novel contribution to the literature.

Social learning is often presented as a mechanism by which maladaptive behaviours could be transmitted, and mathematical modelling has demonstrated that frequency-dependent learning can lead to the widespread adoption of neutral or maladaptive behaviours (Mesoudi, 2011a) (See Chapter 2 Section 2.4.3). This is because frequency-dependent learning results in behaviours being adopted based on frequency, without evaluation of merit (Efferson et al., 2008;Cavalli-Sforza, 1981;Boyd and Richerson, 1985). The findings presented in Chapter 6 suggest that, although frequency-dependent learning is demonstrated to have a role in the persistence of FGC, this appears to be due to the social transmission of adaptive rather than maladaptive behaviours. Social

transmission of adaptive behaviour has been demonstrated in modelling, although empirical examples are rare (Henrich and Henrich, 2010;Henrich and Broesch, 2011).

9.3.2 Paternity concern as a driver of behaviour

Chapter 5 and Chapter 7 examine whether paternity concern may be driving FGC and IPV. The analysis in these studies tests a range of individual and group level factors which could increase men's paternity concern. The results showed that the proxy indicators for paternity certainty were associated with IPV and FGC in different ways. Group rather than individual level proxies were associated with a preference for marrying a woman with FGC. This indicates that group-level sexual activity is used as a cue for assessing paternity concern prior to marriage. By contrast, IPV perpetration within marriage was associated with individual rather than group level proxies for paternity concern, particularly the wife's number of sexual partners. This suggests that once in a relationship non-paternity risk is assessed by the wife's extra-pair sex behaviour. Jealous behaviours, accusations of infidelity and insistence on knowing where their wife is were also associated with IPV perpetration. As proxies are used there could be alternative explanations (discussed in Section 9.5), however the results of both studies suggest that paternity concern may contribute to the prevalence of both IPV and FGC.

The association with paternity concern and marriage preferences is suggested by the further findings from Chapter 5 in which the sample was restricted to matrilineal groups (Appendix Table 5.6). Men in matrilineal groups typically have lower levels of paternal investment and therefore are predicted to have lower concern about paternity (Anderson, 2006;Holden et al., 2003;Trivers, 1972). The findings are indicative, due to low sample size, however, in line with predictions, most proxies for paternity concern were not shown to be significantly associated with marriage preferences for wives with FGC in these matrilineal groups. The same could not be tested for IPV due to sample sizes.

These studies make a contribution to the evolutionary anthropology literature as they test individual variation in the expression of paternity concern rather than the sex-specific nature of paternity concern tested by evolutionary psychologists (Daly et al., 1982;Buss et al., 1992;Edlund et al., 2006). The results suggest that behaviours that might be motivated by paternity concern are expressed in accordance with the risk of non-paternity. To my knowledge the analysis presented in Chapter 5 is the first study to have considered how paternity concern might affect marriage choice, rather than mate choice. Marriage differs to mate choice, particularly in a sub-Saharan African context, due to familial involvement (Mair, 2013). From an evolutionary perspective a man's family will have a vested interest in his marital partner due to their inclusive fitness concerns (Apostolou, 2008). These

studies also make a methodological contribution, suggesting new ways that paternity concern may be assessed using large cross-sectional datasets.

9.4 IMPLICATIONS RELEVANT TO POLICY AND PROGRAMME WORK

Policy makers have struggled to identify culturally acceptable and effective eradication policies which result in sustained behavioural change for either FGC or IPV (outlined in Sections 3.3 and 4.3). Implications arising from this research which could be relevant to policy or programme work, or which merit further investigation as interventions, are described below. In common with findings from other evolutionary anthropological studies, the evidence from the research in this thesis suggests that targeted and context-specific eradication approaches will be more effective than universal policies (Gibson and Lawson, 2015).

9.4.1 Female Genital Cutting

9.4.1.1 Target ethnic groups with FGC prevalence over 50%

Groups in which FGC prevalence is under 50% are predicted to experience a reduction in FGC prevalence over time according to the theory of conformity bias, as individuals are predicted to be disproportionately likely to copy the majority behaviour i.e. not performing FGC (Efferson et al., 2008;Boyd and Richerson, 1985). By the same logic, without intervention FGC prevalence will increase in groups in which FGC prevalence is over 50%. Therefore, eradication programmes should seek to identify ethnic groups in which FGC prevalence is over 50%, and work with these communities to reduce their FGC group prevalence to below 50%, and then the forces of conformity bias could be harnessed to further reduce prevalence. Time series data would be necessary to confirm this prediction. Trends over time in FGC prevalence at the country level (shown in Figure 3.1, Section 3.3.1) demonstrate a clear divide between countries with FGC prevalence of over or under 50%. There has been a reduction in prevalence over the past 30 years in all countries, but in countries where FGC is the norm, prevalence has not gone below the 50% threshold.

9.4.1.2 Community abandonment pledges may not be the only effective approach

Community abandonment programmes are currently the FGC eradication method most favoured and funded by multilateral organisations (discussed in Section 3.3.3) (UNFPA and UNICEF, 2017). However, the research findings and general observations gathered within this thesis support others who have challenged the theoretical basis for community abandonment pledges as well as their efficacy (Shell-Duncan et al., 2011;Efferson et al., 2015;Diop and Askew, 2006). In particular, the question of whether abandonment pledges translate into reduced cutting rates, and whether

changed attitudes are sustained, has not been resolved (Diop and Askew, 2006;Johansen et al., 2013). The findings concerning the frequency-dependent diffusion of FGC suggest that work with targeted individuals, households and communities could play a part in the decline of FGC practice in the overall population. Understanding the community's context and motivations for FGC is important to determine the most effective programme, rather than applying a universal approach to all contexts.

9.4.1.3 Economic development may have a knock-on impact of reducing FGC

The results from Chapters 5, 6 and 8 give support to the theory that modernisation (reviewed Section 3.2.2) will contribute to FGC reduction (Boyle et al., 2002;Inglehart and Baker, 2000). Results from all three studies show that factors associated with economic development and 'modernisation' reduce the risk of FGC being performed and/or reduce support for FGC. These factors include women's education, household wealth and urban rather than rural dwelling. The implication is that policies aimed at economic development will have a knock-on impact of reducing FGC perpetration.

9.4.1.4 Eradication programmes should target mothers who have undergone FGC

Mother's FGC status is shown to have the strongest association with FGC perpetration (Chapter 6); women who have undergone FGC have very high odds of having their daughters cut, whereas women without FGC are unlikely to perpetuate FGC even when living in an ethnic group where FGC is highly prevalent. Mothers' FGC status is also strongly associated with their stated support for FGC (Chapter 8). Together these factors suggest that a switch in behaviour which results in a daughter not being cut will lead to permanent abandonment over generations. Therefore, programmes starting in new communities would benefit from identifying households in which the mothers have undergone FGC and working with these households to bring about change.

9.4.2 Intimate Partner Violence

9.4.2.1 IPV and FGC will benefit from separate interventions

UN Women have recently advocated strengthening the policy linkages between IPV and FGC (UN Women, 2017a). However, the lack of a demonstrable association between FGC and IPV (Chapter 8) challenges whether implementing coordinated programmes to address these behaviours will be effective. In this sample women with FGC were not more susceptible to experiencing IPV, and women who had experienced IPV were not more likely to state their support for the continuation of FGC. This indicates that there will be no knock-on-effect achieved whereby programmes aimed at one behaviour will lead to a reduction in the other. These results suggest that grouping FGC and IPV

interventions together needs further evidence. Targeted programmes tailored to the specific risk factors involved in IPV or FGC, taking the local context into account, may be more successful.

9.4.2.2 Different interventions for different IPV types

Intervention strategies have not typically distinguished between IPV types (Devries et al., 2013b;Ellsberg et al., 2015). However, the results showing different risk factors for IPSV and IPPV (Chapter 7) support other studies which indicate that different risk factors are associated with different IPV types (Abrahams et al., 2004;Abrahams et al., 2006;Koenig et al., 2006;Sambisa et al., 2010;Fulu et al., 2013). Other studies have shown that sexual IPV perpetration has more risk factors in common with non-partner sexual violence (e.g. community violence, involvement in gangs) and therefore may be better grouped with interventions against non-partner sexual violence (Jewkes et al., 2013;Fulu et al., 2013). Primary prevention of sexual violence is starting to be addressed separately, an approach supported by the results of this research (Powell and Henry, 2014).

9.4.2.3 Programme work with men and boys

The results examining IPV show that individual male factors, rather than female, or community factors, are most strongly associated with IPV occurrence (Chapters 7 and 8). These include men's education, alcohol use, attitude towards IPV, number of marriages, polygamy, and controlling behaviours towards their wives. Male behaviours also affect IPV occurrence indirectly as witnessing IPV in childhood increases IPV occurrence in adulthood. The analysis in Chapter 8 found that ethnic group attitudes towards IPV were not associated with IPV occurrence. These results suggest that working with men and boys to change behaviour is key to reducing IPV perpetration, an approach which has been trialled in HIC, e.g. dating violence prevention programmes in schools, but less so in LMIC (reviewed in Section 4.3.3). This could be combined with current popular thinking which promotes social norms change as an effective approach to reducing IPV prevalence, to result in norms change among men and boys (Boyle et al., 2009;Linos et al., 2013;Heise and Kotsadam, 2015).

9.4.2.4 Economic empowerment programmes may increase rather than decrease IPV occurrence

The evidence that access to some form of financial income protects women from IPV is mixed (discussed in Section 4.3.3) (Ellsberg et al., 2015;Heise, 2011;Kim et al., 2007). The analysis in Chapter 7 tested whether women in employment would be less likely to experience IPV, however the results showed no association with physical IPV, but did show that women in employment, irrespective of type of earnings, are at a significantly higher risk of sexual IPV. Rather than providing economic independence, women's earnings and the use of them, may be a trigger for conflict within

a marriage (Vyas and Watts, 2009). It is possible that the association of women's employment with sexual IPV is a consequence of women working away from home and men perpetrating 'mate-guarding' behaviours, rather than IPV relating to the economic consequences of working (Buss and Shackelford, 1997). However, in combination with other studies, these findings query the efficacy of microfinance, job placement or cash transfers as an effective form of primary prevention for IPV (Ellsberg et al., 2015;Heise, 2011;Kim et al., 2007). Unless accompanied by supporting programmes such as gender equality and violence prevention training, schemes which provide women with income may increase rather decrease their IPV risk (Ellsberg et al., 2015).

The apparently contrasting effect of economic opportunities and other indicators of modernisation on FGC and IPV is apparent. The results suggest that employment increases the risk of IPSV, whereas other forms of modernisation such as education, urbanisation and wealth decrease the risk of FGC (See Section 9.4.1.3). This disparity calls for further understanding.

9.5 STUDY LIMITATIONS

The studies presented in this thesis share several limitations related to using cross-sectional survey data. These are discussed in each chapter, as well as the steps taken to address them. These concern the risk of reporting bias, particularly associated with self-reported behaviour of sensitive subjects such as sexual experiences, FGC status and IPV experience, as well as opinions regarding these subjects. Further, cross-sectional data does not allow a temporal relationship between the variables to be established. Temporal relationships are likely to be particularly key for understanding the precise sequence of events leading to women's IPV experience (discussed further in Section 9.6.6). To allow for this, control and experimental variables were selected which can be matched as closely as possible to the timeframe of the IPV incidence, and the large data sample compensates to a certain extent for the lack of detailed time-sequence events (Mattison and Sear, 2016).

A further limitation concerns the use of proxy indicators for reproductive success is an established approach in human behavioural ecology studies where actual reproductive success cannot be measured (Nettle et al., 2013;Mattison and Sear, 2016). However, it is difficult to establish with certainty whether the indicators chosen are explained by ultimate or proximate motivations, as the outcomes may be aligned (Tinbergen, 1963;Laland et al., 2013;Scott-Phillips et al., 2011). For example, a wife's infidelity could be a proximate trigger for her husband to perpetrate IPV, but it could also be an ultimate driver of IPV as her extra-pair sex threatens his evolutionary fitness. Proving that IPV perpetration has an ultimate motivation and that it enhances men's evolutionary fitness would require data demonstrating that men gain a fitness benefit from their behaviour (Stieglitz et al., 2018). However, men's reproductive success is difficult to measure as paternity is

uncertain within a marriage, and additional children may have been fathered in other formal or informal relationships. Therefore, genetic data would be required which is hard to obtain (e.g. (Strassmann et al., 2012)).

In all research chapters ethnic group has been used as the meaningful reference group which might influence individual behaviour (Boyd and Richerson, 1985;Efferson et al., 2008). This is justified by the high intra-ethnic marriage rates between groups within the study, and the association between ethnic group and varying FGC practice, and anthropological studies which document ethnic group to be an important determinant of individual behaviour (Abusharaf, 2001;Gruenbaum, 2005;Pemunta, 2012;Yoder and Wang, 2013;Kaplan et al., 2013b;Ross et al., 2016). However ethnic groups can be geographically dispersed and social network analysis would be needed to examine the influence of direct neighbours, friends or work colleagues, who may be from different ethnic groups, on these behaviours.

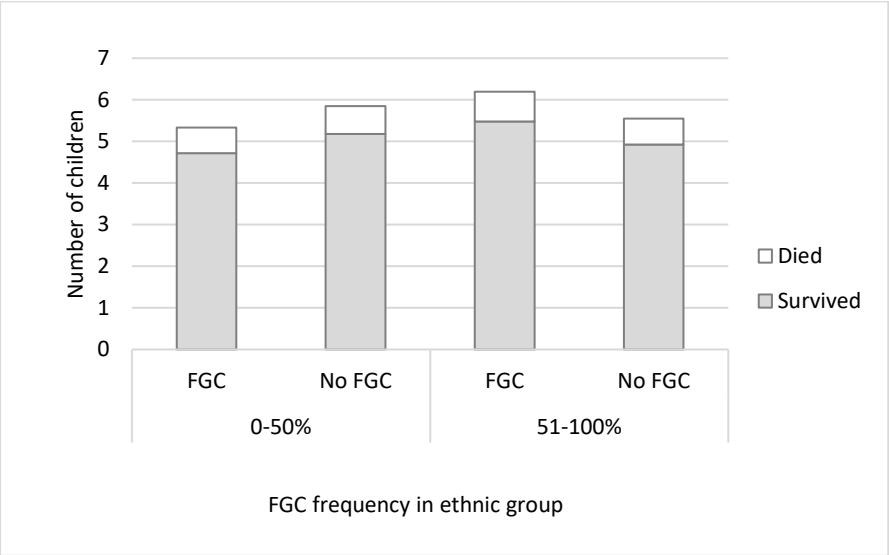
9.6 OUTSTANDING QUESTIONS

9.6.1 Mechanisms behind varied reproductive success associated with FGC status

Differing fitness consequences were found in Chapter 6 in relation to FGC status depending on context, (discussed in Section 9.2.1.2). The mechanism behind these fitness differences was not tested, and it is unclear whether the higher reproductive success experienced by women with the 'preferred' FGC status for their ethnic group is explained by higher fertility or lower child mortality.

To explore this question the same data used in Chapter 6 was analysed to compare fertility and child mortality between women with or without FGC living in groups where the FGC prevalence is over or under 50% (illustrated in Figure 9.1). This analysis shows that average child mortality is similar across all groups, ranging between 0.6 - 0.7 children, whereas women with the 'preferred' status have higher fertility in either context. On average, in groups where FGC is the minority behaviour, fertility for women without FGC was 5.9 children compared to 5.3 for women with FGC, and in groups where FGC is the majority behaviour, fertility for women with FGC was 6.2 children compared to 5.6 for women without FGC.

Figure 9.1 Fertility for women aged 40-49 years by FGC status in ethnic groups where FGC prevalence is under or over 50%



The finding that women with FGC get married at a younger age (Chapter 5) may be pertinent to the fertility differences observed here (Figure 9.1). Earlier age at first marriage could explain the higher fertility for women with FGC living in ethnic groups where FGC prevalence is over 50% (Westoff, 2003). However, it is harder to reconcile the marital differences with the lower fertility observed for women with FGC who are living in ethnic groups with low FGC prevalence. Further work would be required to understand these differences and the interaction between age at first marriage, age at first birth and subsequent birth intervals, and the impact of education and gender roles on fertility in these varying contexts.

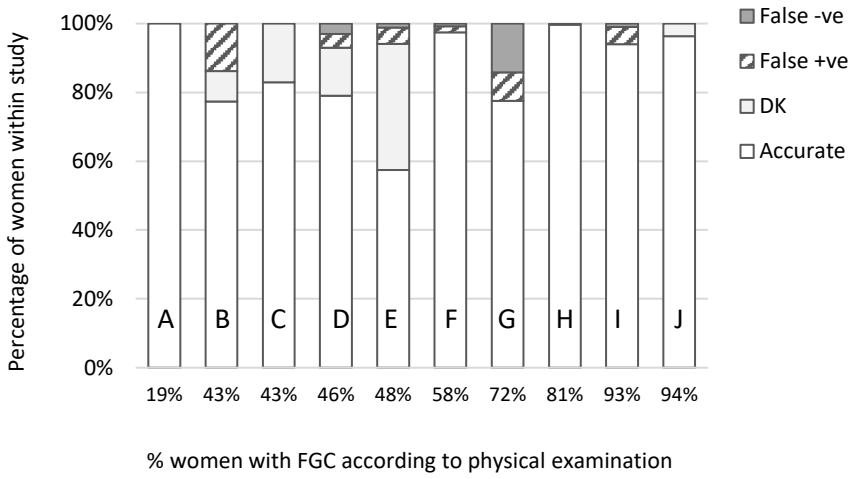
9.6.2 Would there be a benefit from 'cheating'?

The results show that having undergone FGC confers evolutionary fitness benefits in certain contexts. However, FGC is not risk free, and FGC status is not publicly observable (Berg and Underland, 2013). These observations raise the question of whether parents could 'cheat' by pretending that their daughters have been cut, gaining societal and evolutionary fitness benefits, without bearing the associated costs. There are accounts of doctors and traditional practitioners agreeing to pretend to perform FGC to satisfy onlookers (Grassivaro, 2016;Gruenbaum, 2006;Abusharaf, 2013). The public nature of FGC in some communities, performed on groups of girls together, may be a means to ensure that individuals do not cheat (Wilson, 2008). However not all FGC procedures take place among peer groups, and where FGC takes place in private the opportunity to 'cheat' appears greater.

To explore this further, studies which compared women's self-reported FGC status with their FGC status assessed through physical examination, were identified and analysed (See Figure 9.2 below). Inaccurate self-reports could be due to various reasons: women may have been given inaccurate information by their parents; women may not know their actual FGC status; or, women may provide incorrect information intentionally. Responses may also be affected by participants' knowledge that the interview will be followed by physical examination, however this is not clear from the methods of these studies. FGC self-report was found to be consistent with physical examination in most cases, however, inconsistencies were observed. A number of women in six of the studies stated that they had undergone FGC but physical examination found no evidence (false positives) (Odujinrin et al., 1989;Snow et al., 2002;Adinma, 1997;Morison et al., 2001;Klouman et al., 2005a;Huntington et al., 1996). In several studies women stated that they did not know their FGC status, in two of these studies physical examination revealed that some of these women had undergone FGC; 29 out of 314 (Okonofua et al., 2002), and 36 out of 239 (Snow et al., 2002). Four studies also found women who stated they had not undergone FGC but did have some form of FGC (false negatives) (Snow et al., 2002;Adinma, 1997;Klouman et al., 2005a;Huntington et al., 1996). Inconsistencies could relate to the age at cutting, however this was not captured in the studies.

To align with the frequency-dependent results of Chapter 5 it was anticipated that there would be more false positives in areas of high FGC prevalence, and more false negatives in areas of low FGC prevalence. This does not appear to be the case, although the FGC prevalence in the community which the respondents came from was not captured, and FGC prevalence is taken from the sample alone. However, the number of false positives illustrates that a small proportion of women are reporting incorrectly that they have been cut, either intentionally or unintentionally. Misinformation regarding a girl's FGC status could be more prevalent amongst her community (and potential marriage partners) where no physical examination will be performed. Further studies are needed to understand whether social mechanisms exist to detect or deter 'cheating' given the importance attributed to FGC status in many communities.

Figure 9.2 Comparison of self-reported FGC status with physical examination



Note:
False +ve (women reported having FGC, but physical examination found no evidence of FGC)
False -ve (women reported not having FGC, but physical examination found evidence of FGC)
DK (women reported they did not know their FGC status)

Table 9.2 Sample sizes and data used for analysis of women's self-reported and physically examined FGC status

	Sample (n)	Country	Reference
A	250	Sudan	(Elmusharaf et al., 2006)
B	181	Nigeria	(Odujinrin et al., 1989)
C	1,836	Nigeria	(Okonofua et al., 2002)
D	1,709	Nigeria	(Snow et al., 2002)
E	256	Nigeria	(Adinma, 1997)
F	1,157	The Gambia	(Morison et al., 2001)
G	396	Tanzania	(Klouman et al., 2005a)
H	554	Sierra Leone	(Bjälkander et al., 2013)
I	1,339	Egypt	(Huntington et al., 1996)
J	279	Sudan	(Elmusharaf et al., 2006)

9.6.3 What role do men play in perpetuating FGC?

The role that men may play in the persistence of FGC is unclear, and one that researchers have struggled to understand (Varol et al., 2015;Kaplan et al., 2013a). Although mothers and elder female relatives are generally observed to be responsible for organising a girl's FGC procedure, men are recognised to have indirect or direct influence over FGC in a number of capacities; as fathers involved in the decision regarding their daughter's FGC, as a parent involved in arranging their son or daughter's marriage, as an individual arranging his own marriage, and as community or religious leaders influencing others (Sabahelzain et al., 2019;Bjälkander et al., 2012;Almroth et al., 2001b;Shell-Duncan et al., 2010). The lack of clarity of men's roles in relation to FGC may reflect that men's opinions concerning FGC vary depending on their relation to the woman involved.

Men's opinions regarding FGC are typically captured by asking men whether they think FGC should be stopped or continued, and many surveys find greater support for FGC being stopped by men than by women, which is hard to reconcile with suggestions that men are perpetuating the practice (Varol et al., 2015;Yoder and Wang, 2013;Gage and Van Rossem, 2006) (and see Appendix Figure 5.1a and 5.1 b). As FGC is often rationalised as way of controlling women's sexual behaviour for the benefit of men, male support for FGC abandonment appears contradictory (Kaplan et al., 2013a). However, several arguments suggest that men's opinions regarding FGC captured in surveys may not reflect their true opinions.

Firstly, it has been shown that publicly stated opinions regarding FGC may understate men's true levels of support for the practice among older, educated men (Gibson et al., 2018). Secondly the results of Chapter 5 (also (Reason, 2004)) suggest there is a preference for marriage to women with FGC. The FGC status of men's wives may be a better measure of men's opinions on FGC than attitudinal data captured in surveys. Further, analysis of the data used in Chapter 5 demonstrates that a varying proportion of men who stated in the DHS survey that they think FGC should be stopped are married to women with FGC (80% of men in Mali and Burkina Faso, 40% in Nigeria and 50% in Ivory Coast). Likewise, some men who stated that FGC should be continued are married to women without FGC; (3% in Mali, 18% in Burkina Faso and Ivory Coast, and 31% in Nigeria). Many factors could contribute to men's stated opinions regarding FGC contrasting with the FGC status of their wives e.g. their opinion could have changed since marriage, or their wives' FGC status might reflect their parents' FGC preferences rather than their own (discussed in Section 9.6.4), and men's opinions are also likely to be heterogenous. However, this disparity provides further evidence that attitudinal support captured in surveys should be interpreted with caution.

In addition to methods which capture hidden support for FGC (Gibson et al., 2018), further research is needed to understand how men's opinions concerning FGC may vary in relation to their daughter, their wife or their daughter-in-law. Although there are exceptions (e.g. Gibson et al., 2018) men are rarely asked about the desirability of FGC for women they have different relationships with. A theme is emerging from qualitative studies that fathers play a greater role in decision-making for their daughters than had been previously recognised, often steering the decision not to have their daughter cut, as found in Sierra Leone, Sudan and Senegal (Sabahelzain et al., 2019;Bjälkander et al., 2012;Almroth et al., 2001b;Shell-Duncan et al., 2010). A deeper understanding of men's opinions or support for FGC will inform the potential contribution men can make in supporting eradication efforts (Varol et al., 2015;Kaplan et al., 2013a).

9.6.4 How does FGC influence marriage discussions?

The association between FGC and marriageability is referred to in many qualitative accounts which document that FGC is required for marriage, or is practised to improve a girls marriage prospects (Van Rossem and Gage, 2009;Berg and Denison, 2013;Abathun et al., 2016). Some theoretical interpretations of FGC propose that marriageability is the primary driver of FGC (Mackie, 1996). However, marriage preferences can only have an indirect effect on the persistence of FGC. To my knowledge no studies have asked parents whether marriage prospects factor into their decision to have FGC performed on their daughters, and the mechanisms by which FGC influences marriage arrangements are largely undocumented. Marriages in sub-Saharan Africa are often arranged by the couple's families, and FGC status may influence marriage opportunities through bridewealth negotiations or marriage preferences (Mair, 2013;Meekers, 1992). It is also proposed (although untested) that parents may have an economic motivation for performing FGC on their daughters in order to receive higher bridewealth payments (Shell-Duncan et al., 2000;Boyden et al., 2012).

Bridewealth payments (from the groom to the bride's family) can be fixed, however variation in bridewealth according to the bride's desirability has been observed in many ethnic groups, particularly in East Africa (Borgerhoff Mulder, 1995;Goldschmidt, 1974;Laughlin, 1974). It is anticipated that bridewealth may vary with FGC status, particularly where women with FGC are preferred for marriage (Borgerhoff Mulder, 1995;Apostolou, 2008). However, a relation between bridewealth and FGC is documented in only two studies, one finding that bridewealth payments can be dependent on a woman having FGC, the other finding that a portion of the bridewealth is for the costs of an intended bride's FGC procedure (Shell-Duncan et al., 2000;Groszngate, 1988). Other detailed accounts of bridewealth in communities in which FGC is practised make no mention of FGC status being part of the negotiations (Hampshire and Smith, 2001;Mondain et al., 2007).

As a woman's FGC status is not visible, it is unclear how the groom's family would establish a potential bride's FGC status with certainty. Where FGC is performed within peer groups a woman's FGC status may be known within the community, but if performed in private, her FGC status may not be known. Virginity testing at marriage is commonly reported and discussed in the literature, however 'FGC testing' is not mentioned (Wadesango et al., 2011). Many questions concerning the influence of FGC status on marriage remain unknown. It is undocumented whether the FGC status of potential brides is openly referred to in marriage discussions, and whether the 'wrong' status would prevent a marriage from taking place. Likewise, it is unclear if bridewealth payments are higher for women with FGC and if so, what the reasons for this difference might be. Ethnographic research is

required to understand the importance placed on FGC status during marriage arrangements, and the implications that this may have on the persistence of FGC practice.

9.6.5 The influence of social norms on FGC and IPV

The influence of group behaviours, beliefs and attitudes on individual behaviour is a consistent theme throughout this thesis. This is an area of common ground between human behavioural ecologists who consider human behaviour as adaptive responses to social context (Laland and Brown, 2011), cultural evolutionists interested in how behaviours can spread between individuals thereby reacting to, as well as influencing, the social context (Mesoudi, 2011b) and international development practitioners who are interested in how social context influences beliefs and behaviour (Mackie et al., 2015).

Although there is common ground, the definitions and terms differ, and the extent of the theoretical overlap is unclear. The concept of social norms used by international development practitioners predicts that social expectations are based on beliefs about typical or appropriate behaviour rather than actual behaviour, and does not imply that a behaviour is normative (Alexander-Scott et al., 2016;Heise and Manji, 2016;Mackie et al., 2015). In contrast, the theoretical expectations of conformity bias or frequency-dependent behaviour described by cultural evolutionary theory are more concerned with the transmission of actual behaviours, and frequency-dependent bias could result in a behaviour being normative (Efferson et al., 2008;Boyd and Richerson, 1985). Bringing together ideas from social norms theory and theories of cultural evolution could be a fruitful area of further study in relation to harmful practices, potentially leading to improved predictions about how best to bring about behavioural change.

9.6.6 Immediate triggers for behaviours

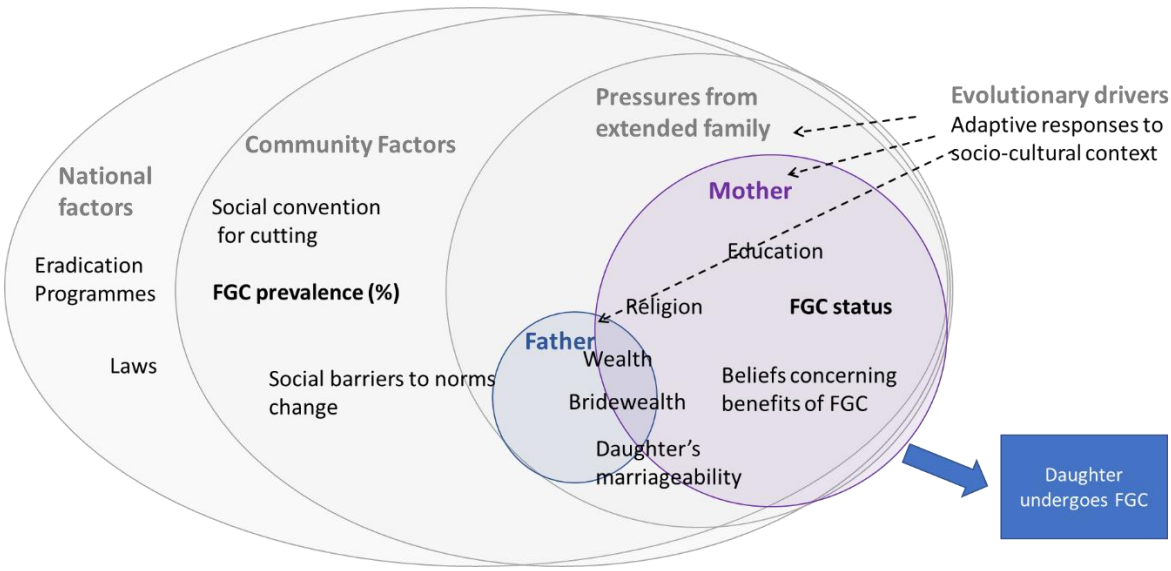
Risk factors associated with FGC and IPV can be identified from statistical analysis of survey data, however, to fully understand both proximate and ultimate perpetrator motivations a more detailed insight into the decision processes leading to FGC and IPV would be required.

For IPV the question of immediate triggers relates to the sequence of events that lead to the different types of IPV being perpetrated. Many studies on IPV perpetration rely on identifying risk factors from cross sectional data, however this makes the temporal relationship between events difficult to establish, for example whether alcohol use occurred before or after IPV perpetration. This is particularly the case when there are multiple IPV events. The need for a better conceptual framework to capture the perceptions of perpetrators and victims about why IPV occurred has been recognised (Flynn and Graham, 2010). A systematic review of perceived motivations attributed by

victims and perpetrators indicates that similar factors are attributed to physical IPV by victims and perpetrators, but different factors to sexual IPV (Neal and Edwards, 2017). However, no similar studies to my knowledge have been performed in LMIC contexts. Further studies are needed in order to get a better understanding of the events which lead to IPV perpetration. For example, to understand when or whether IPV is premeditated or intentional, and whether different events lead to sexual or physical IPV. Due to the methodological issues surrounding recall bias and multiple events, ethnographic study would be informative.

The unknown immediate triggers for FGC relate to the decision-making for a daughter to undergo FGC. Decision-making has been the subject of a limited number of qualitative studies which reveal differences by context; in Sudan FGC decisions are found to result from the deliberations of many family members (Sabahelzain et al., 2019) and in Senegal the role of older women within the family, as well as the importance of upholding traditions and social norms, are influential (Shell-Duncan et al., 2018;Bjälkander et al., 2012). Fathers' influence has also been documented in preventing their daughter's FGC in Sierra Leone, Sudan and Senegal (Sabahelzain et al., 2019;Bjälkander et al., 2012;Almroth et al., 2001b;Shell-Duncan et al., 2010), although not in The Gambia (Kaplan et al., 2013a). However, the authors of these studies stress the context-specific nature of their findings. Further studies are needed to understand the decision-making process in varied contexts, and which family members are leaning towards which outcome, in order to inform targeted interventions geared towards abandonment.

Figure 9.3 Ecological Framework for FGC decision-making



Shell-Duncan refers to the "constellation of decision-makers" who influence the cutting decision, and identifies decision-making that takes place at the community, family and individual levels (Shell-Duncan et al., 2010). This is a similar concept to the ecological framework applied to many health behaviours including IPV perpetration (Heise, 1998;Richard et al., 2011) (see Section 4.3.7). I have adapted this concept to create an ecological framework for FGC decision-making. This illustrates the risk factors for FGC at different levels, which have been drawn from the literature as well as findings from Chapter 5, 6 and 8. Important factors are highlighted in bold (Figure 9.3). Additionally, evolutionary pressures on different family members are incorporated into the framework. It is anticipated that the relative influence of each factor will vary by context. Identifying the strength of association with any of these factors by context could be used in programme work to target programme work at the factors causing the highest risk.

9.6.7 Do these findings apply outside sub-Saharan Africa?

In this study data was restricted to countries in sub-Saharan Africa, the area with the highest density of FGC. However, FGC is found elsewhere in Africa (Egypt;87% and Sudan; 87%), as well as Asia (Indonesia; 49%, Yemen; 19%; and Iraq; 7%), and IPV is found in all countries. It is anticipated that the research findings from Chapters 5-8 would apply in all contexts as they are based on evolutionary theory and ultimate causes, rather than proximate mechanisms (Tinbergen, 1963). However, analysis of the data from these countries would be required to confirm this prediction.

9.7 CONCLUSION

The overall aim of this thesis is to gain insights into the persistence of female genital cutting (FGC) and intimate partner violence (IPV) in current populations. Due to the widespread impact on women and girl's well-being, the motivations behind IPV and FGC are of interest to policy-makers, and increasingly to evolutionary anthropologists (Gibson and Lawson, 2015). In three of the four research chapters an evolutionary approach was applied to FGC and IPV behaviours, which anticipates that behaviours that are detrimental to well-being may be maintained in a population provided they lead to higher evolutionary fitness (Hill, 1993). The fourth research chapter tested for an association between IPV experience and FGC status and support. Important new drivers were identified which contribute to understanding the persistence of FGC and IPV.

Original contributions to knowledge include a new understanding of the interaction between cultural and evolutionary drivers of FGC. FGC behaviour was shown to be socially transmitted via frequency-dependent learning, with parents' decision to have their daughters cut being associated with how frequent FGC is within their ethnic group. Further, the observed frequency-dependent

effect was shown to have evolutionary fitness benefits, measured by the women's number of surviving offspring. These novel findings provide empirical evidence of a social learning mechanism that is also adaptive in evolutionary fitness terms.

Further contributions to knowledge concern the effect of FGC status on marriage opportunities, which may influence parents to have FGC performed on their daughters. A preference for marriage to women with FGC is indicated in ethnic groups where extra-pair sexual activity is greater. The results suggest that, although FGC may not be a reliable indicator of greater paternity confidence, concern about paternity may be one of several factors contributing to the persistence of FGC.

Intimate partner violence was examined in an original approach bringing together different evolutionary theories for IPV together in one study using an evolutionary sexual conflict framework, testing physical and sexual IPV separately. The results indicate that evolutionary fitness concerns may be a motivating factor for physical IPV, explaining its perpetration in certain contexts. Men in relationships where the risk of non-paternity is perceived to be higher may use IPV to reduce this risk. Men who are diverting resources away from their marriage, possibly in pursuit of their own fitness goals, are also shown to be more likely to perpetrate IPV. The evidence for evolutionary motivations driving sexual IPV perpetration was weak. This may be because the proxies used in the models were not representative of sexual IPV concerns. However, this result may also indicate that sexual IPV serves no fitness benefit. IPV of all types carry numerous evolutionary costs and men may achieve higher fitness in their intimate partnerships by using less costly strategies.

An important policy implication from the research findings is that FGC status and IPV experience are not shown to be associated. The UN Women have recently advocated strengthening the policy linkages between IPV and FGC (UN Women, 2017a). They also identified research gaps concerning the association between these two behaviours which are addressed in this study. Rather than implementing joint programmes, these results suggest it will be more effective to create targeted programmes tailored to the specific risk factors involved in IPV or FGC, taking the local context into account.

Further implications for policy work identified by the research findings include the importance of developing intervention programmes tailored to the specific risk factors involved in sexual IPV and physical IPV separately. In relation to FGC the results indicate that targeting communities in which FGC prevalence is over 50% will be an effective strategy. The research studies in this thesis demonstrate the value of applying an evolutionary approach to understanding harmful practices, and reveal how evolutionary and cultural forces may contribute towards the persistence of FGC and IPV.

APPENDICES

CHAPTER 5 – APPENDICES

Appendix Table 5.1 Descriptive statistics of female respondents by country and FGC status

		MALI		SENEGAL		NIGERIA		BURKINA FASO		IVORY COAST		TOTAL	
		No FGC	**FGC**	**No FGC**	**FGC**	**No FGC**	**FGC**	**No FGC**	**FGC**	**No FGC**	**FGC**	**No FGC**	**FGC**
FGC Type:													
No FGC		1,509		8,539		10,023		4,134		5,292		29,497	
'Skin nicked'			367		579		230		1,875		181		3,232
'Flesh removed'			8,708		3,255		4,329		10,331		3,040		29,663
'Sewn closed'			1,249		693		462		136		269		2,809
Type Unknown			1,418		1,162		3,443		555		659		7,237
Total			**11,742**		**5,689**		**8,464**		**12,897**		**4,149**		**42,941**
Education:	None	1,068	9,125	5,067	3,727	2,960	1,785	2,362	10,663	2,289	3,082	13,746	28,382
	Some	441	2,617	3,472	1,962	7,063	6,679	1,770	2,829	3,003	1,067	15,749	15,154
Religion:	Christian/other	177	926	475	111	6,289	5,764	2,268	4,511	3,962	1,339	13,171	12,651
	Muslim	1,325	10,748	8,064	5,578	3,687	2,679	1,853	8,351	1,320	2,802	16,249	30,158
Residence:	Urban	558	4,235	3,773	2,081	4,205	3,559	1,614	3,713	2,592	1,806	12,742	15,394
	Rural	951	7,507	4,776	3,608	5,998	4,905	2,493	9,183	2,700	2,343	16,918	27,546
Age (mean, SD)		28.6 (9.7)	28.5 (9.5)	27.9 (9.1)	28.2 (9.3)	28.7 (9.1)	30.5 (9.6)	24.6 (8.4)	30.2 (9.4)	27.9 (9.1)	29.7 (9.3)	27.7 (9.2)	29.5 (9.5)
Age at first intercourse (mean, SD)		16.2 (3.2)	15.9 (2.5)	17.8 (4.3)	16.4 (3.5)	17.0 (3.6)	17.8 (3.7)	17.2 (2.5)	17.1 (2.5)	16.2 (2.4)	16.2 (2.6)	17.0 (3.5)	16.7 (3.0)
Age at first marriage (mean, SD)		17.1 (3.7)	17.0 (3.4)	18.9 (4.9)	17.5 (4.3)	18.5 (4.9)	19.7 (4.9)	18.1 (3.0)	17.9 (3.9)	19.8 (4.9)	18.4 (4.1)	18.3 (4.7)	17.0 (3.9)
Sex before marriage	No	922	6,406	4,393	2,879	4,229	3,373	1,879	8,049	1,007	1,697	12,430	22,404
	Yes	141	2,131	885	622	2,179	2,190	433	1,349	1,711	1,062	5,349	7,354
Sex 2yrs + before marriage	No	979	7,092	4,646	3029	4,767	3,949	2,033	8,520	1,274	1,902	13,699	24,492
	Yes	84	1,445	632	472	1,641	1,614	279	878	1,444	857	4,080	5,266
Unmarried women had sex	No	175	1,059	2,125	801	1,276	1,079	990	1,061	381	257	4,947	4,257
	Yes	10	167	305	270	1,381	937	399	504	1,423	416	3,518	2,294
Childbirth before marriage	No	1,086	8,381	4,766	3,625	5,906	5,388	2,284	10,230	2,065	2,621	16,107	30,245
	Yes	70	983	796	636	949	792	162	544	1,711	714	3,688	3,669
Sex other than husband	No	999	8,404	5,279	3,467	6,419	5,578	2,217	9,237	2,532	2,712	17,446	29,398
	Yes	41	405	24	61	71	38	38	66	80	43	254	613
2+ sexual partners in lifetime	No	824	6,238	4,586	2,724	4,533	3,761	1,880	7,488	1,115	1,603	12,938	21,814
	Yes	239	2,413	927	1,024	3,101	2,647	826	2,404	2,995	1,555	8,088	10,043

See Methods Section 5.2.2 for calculations and sample used in sexual activity indicators

Not all respondents gave information for all variables or are eligible for all categories (e.g. married) therefore not all totals are equal.

Appendix Table 5.2 Prevalence of sexual activity indicators for men and women by ethnic group and country

	FGC status of first wife				Men			Women		
	No FGC	FGC	Total	% FGC	PMS %	EMS %	SPs average	PMS %	EMS %	SPs average
Bambara	9	526	535	98.6	54.0	13.1	4.1	25.2	6.1	1.4
Malinke	0	160	160	100.0	60.5	14.1	4.9	31.3	6.2	1.6
Peulh	11	279	290	96.7	44.8	9.2	4.8	24.4	5.4	1.4
Sarkole	1	175	176	99.5	45.6	9.3	3.8	17.5	3.0	1.3
Sonrai	50	55	105	52.3	45.6	14.0	5.9	13.8	3.6	1.4
Dogon	25	182	207	88.2	52.0	15.3	3.6	21.9	4.8	1.2
Tanachek	31	4	35	11.1	39.4	5.0	3.4	21.7	3.3	1.2
Senoufo	11	211	222	95.3	39.3	16.5	3.3	30.0	8.2	1.4
Bobo	15	25	40	63.8	40.2	8.8	4.0	30.1	8.2	1.5
Mali	**153**	**1,617**	**1,770**	**91.2**	**49.8**	**12.7**	**4.2**	**24.3**	**5.1**	**1.4**
Wolof	450	27	477	6.3	49.0	4.3	3.1	15.3	1.2	1.2
Serer	130	13	143	9.4	62.3	4.4	4.2	16.8	3.3	1.3
Diola	24	34	58	59.4	78.5	11.1	4.6	50.7	18.8	1.9
Poular	150	368	518	71.6	59.6	9.9	4.3	14.9	3.3	1.5
Soninké	6	11	17	65.5	57.7	4.5	3.9	15.5	4.4	1.3
Mandingue	16	99	115	86.6	67.2	7.6	3.8	19.2	7.3	1.5
Senegal	**776**	**552**	**1,328**	**42.2**	**57.1**	**7.8**	**3.8**	**16.3**	**3.2**	**1.4**
Ekoi	43	28	71	39.2	79.1	16.2	8.4	48.4	23.2	1.8
Fulani	134	38	172	22.8	18.0	1.1	2.3	9.0	1.1	1.2
Hausa	422	237	659	36.9	12.1	1.2	2.0	7.1	1.1	1.2
Ibibio	65	18	83	22.8	82.3	18.3	7.4	66.8	28.3	2.4
Igala	20	1	21	5.2	65.8	8.4	3.3	27.6	10.5	1.3
Igbo	228	377	605	62.3	80.8	5.5	4.4	44.7	14.7	1.7
Ijaw/ Izon	122	66	188	35.1	85.7	24.7	8.3	67.6	27.6	2.4
Kanuri/	152	3	155	2.2	12.7	1.0	2.3	7.4	1.0	1.3
Tiv	51	3	54	6.5	84.6	39.2	7.6	40.2	19.4	2.4
Yoruba	233	647	880	74.6	83.3	10.3	4.3	50.3	13.3	1.6
Nigeria	**1,470**	**1,418**	**2,888**	**49.2**	**58.2**	**7.9**	**4.1**	**35.2**	**11.1**	**1.6**
Bobo	36	114	150	76.9	56.3	9.2	3.4	18.5	6.6	1.4
Dioula	6	25	31	81.9	71.8	7.3	3.8	27.0	14.4	1.5
Fulfuldé	64	293	357	82.8	56.0	6.1	3.4	6.1	2.7	1.2
Gourmatché	93	171	264	65.5	47.9	7.0	3.7	5.0	3.3	1.2
Gourounsi	85	109	194	56.2	69.0	9.2	3.1	27.3	11.2	1.7
Lobi	10	114	124	92.2	56.2	7.7	4.9	12.4	8.7	1.5
Mossi	274	1,638	1,912	86.2	65.0	8.9	3.7	16.7	6.5	1.3
Sénoufo	32	222	254	87.4	75.1	7.8	3.8	25.6	8.3	1.4
Touareg	51	31	82	38.5	65.9	9.6	4.5	0.3	1.2	1.2
Dagara	29	115	144	80.6	37.2	4.4	3.3	18.2	7.3	1.6
Bissa	13	101	114	89.6	55.2	8.0	3.2	13.3	6.3	1.2
Burkina Faso	**693**	**2,933**	**3,626**	**81.3**	**62.7**	**7.7**	**3.6**	**15.2**	**6.4**	**1.3**
Bete	43	3	46	7.2	93.7	47.2	16.2	69.5	35.3	3.9
Agni	85	5	90	6.3	83.7	31.4	13.6	71.8	29.2	2.8
Baoule	230	6	236	3.4	89.8	29.5	10.9	70.6	33.5	2.8
Koulango	29	12	41	29.6	90.9	28.6	8.9	59.7	24.2	2.4
Gouro	33	20	53	38.8	80.1	31.8	11.5	56.8	21.4	2.9
Guere	15	16	31	52.9	81.2	59.7	19.1	69.2	30.7	3.6
Yacouba	15	67	82	82.9	92.1	40.8	17.7	65.3	28.8	3.4
Dioula	22	76	98	78.5	71.1	13.3	5.5	23.0	9.2	1.8
Malinke	27	79	106	75.0	87.3	18.5	8.6	38.4	16.3	1.8
Koyaka	11	44	55	80.1	84.5	17.5	7.9	52.2	17.4	2.1
Senoufo	40	203	243	84.0	68.4	20.2	7.0	30.8	14.6	1.8
Ivory Coast	**550**	**531**	**1,081**	**49.8**	**82.6**	**26.1**	**10.3**	**51.2**	**8.3**	**2.5**
TOTAL	**3,642**	**7,051**	**10,693**	**65.9**	**60.1**	**10.2**	**4.5**	**25.9**	**8.5**	**1.5**

PMS = premarital sex, **EMS** = extramarital sex, **SPs average** = average no. of sexual partners in lifetime

Appendix Table 5.3 Multilevel multivariate logistic regression analysis investigating the odds of different extra pair sex indicators among female respondents aged 15-49 years; analysing FGC type separately with the reference category of No FGC.

	PREMARITAL												EXTRAMARITAL			GENERAL		
	Sex before marriage			Sex 2 or more years before marriage			Unmarried women who have had sex			Childbirth before marriage			Extramarital sex during previous 12m			2 or more lifetime sexual partners		
Sample			**n 40,585**			**n 40,585**			**n 12,395**			**n 41,196**			**n 38,838**			**n 39,164**
Women with outcome:			*25.5% n 10,346*			*18.5% n 7,502*			*35.0% n 4,448*			*7.0% n 2,915*			*3.0% n 1,167*			*24.2% n 9,476*
Fixed effects	**OR**	**(95% CI)**	**p**	**OR**	**(95% CI)**	**p**	**OR**	**(95% CI)**	**p**	**OR**	**(95% CI)**	**p**	**OR**	**(95% CI)**	**p**	**OR**	**(95% CI)**	**p**
FGC 'skin nicked'	1.060	0.918-1.223	0.426	1.129	(0.952-1.338)	0.164	1.188	(0.892-1.581)	0.237	1.018	(0.769-1.348)	0.898	0.950	(0.661-1.366)	0.782	0.720	(0.620-0.835)	0.000
FGC 'flesh removed'	0.940	0.869-1.017	0.124	0.979	(0.893-1.074)	0.646	1.117	(0.993-1.257)	0.064	1.083	(0.935-1.255)	0.285	1.044	(0.870-1.253)	0.645	0.875	(0.813-0.943)	0.000
FGC 'sewn closed'	0.942	0.807-1.099	0.446	1.057	(0.884-1.263)	0.549	0.951	(0.663-1.364)	0.787	0.837	(0.627-1.116)	0.224	1.105	(0.795-1.536)	0.551	0.631	(0.529-0.752)	0.000
FGC type unknown	0.887	0.798-0.986	0.026	0.967	(0.856-1.091)	0.583	1.014	(0.860-1.196)	0.865	1.265	(1.038-1.542)	0.019	1.002	(0.781-1.285)	0.986	0.732	(0.660-0.812)	0.000
Some education (none)	1.181	1.102-1.264	0.000	1.195	(1.103-1.295)	0.000	1.147	(1.004-1.310)	0.044	1.511	(1.336-1.710)	0.000	3.501	(3.022-4.055)	0.000	2.219	(2.048-2.405)	0.000
Rural (urban)	0.888	0.835-0.943	0.000	0.954	(0.889-1.024)	0.190	0.819	(0.722-0.928)	0.002	0.670	(0.586-0.767)	0.000	0.406	(0.354-0.465)	0.000	0.630	(0.591-0.672)	0.000
Muslim (Christian other)	0.814	0.750-0.884	0.000	0.796	(0.723-0.876)	0.000	0.873	(0.765-0.995)	0.042	1.008	(0.858-1.184)	0.926	0.605	(0.493-0.741)	0.000	0.752	(0.693-0.817)	0.000
Matrilineal (patrilineal)	0.867	0.453-1.658	0.666	0.918	(0.482-1.745)	0.496	1.178	(0.545-2.545)	0.676	1.212	(0.756-1.945)	0.415	1.361	(0.748-2.474)	0.313	0.973	(0.418-2.265)	0.950
Age at survey	0.976	0.972-0.980	0.000	0.977	(0.973-0.981)	0.000	1.240	(1.216-1.264)	0.000	0.965	(0.959-0.970)	0.000	0.959	(0.951-0.966)	0.000	1.013	(1.009-1.017)	0.000
Age at 1st marriage	1.292	1.277-1.307	0.000	1.383	(1.361-1.404)	0.000	..	..	..	1.608	(1.579-1.636)	0.000	1.009	(0.989-1.029)	0.407	..	..	..
Age at 1st intercourse	..	..	..	..	..	..	..	..	..	0.618	(0.604-0.633)	0.000	0.932	(0.905-0.960)	0.000	0.904	(0.893-0.915)	0.000
Ever married (never)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0.677	(0.621-0.738)	0.000
Wealth (5 point scale)	..	..	..	..	..	..	0.935	(0.892-0.980)	0.005	..	..	..	..	..	..	..	..	..
Random effects	**Variance**	**(S.E.)**	**p**	**Variance (S.E.)**		**p**	**Variance**	**(S.E.)**	**p**	**Variance**	**(S.E.)**		**Variance**	**(S.E.)**		**Variance**	**(S.E.)**	**p**
Ethnic group variance	0.507	(0.116)	0.000	0.481	(0.112)	0.000	0.629	(0.156)	0.000	0.211	(0.058)	0.000	0.353	(0.097)	0.000	0.885	(0.200)	0.000
Country variance	0.639	(0.439)	0.150	0.821	(0.556)	0.140	1.426	(0.956)	0.136	0.273	(0.192)	0.155	0.177	(0.145)	0.313	0.641	(0.473)	0.175
Ethnic group ICC	13.3%			12.8%			16.1%			6.0%			11.0%			21.2%		
Country ICC	23.3%			20.0%			30.2%			7.7%			15.4%			16.1%		

Notes:

Sample size varies, but for all models level 2 (ethnic group) n=47, and level 3 (country) =5

See methods Section 2.2, Table 1, for inclusion criteria and calculation of outcome variables for each model

The reference category is given in brackets for categorical variables

Not all predictor variables are relevant to all models, see methods Section 2.2

ICC is the intra-class correlation coefficient, also known as the variance partition coefficient. This gives a measure of the variance in outcome attributable to the different levels in the model. The remaining unexplained variation is due to individual-level factors.

Appendix Table 5.4 Bivariate Pearson correlation between FGC prevalence and prevalence of three different extra-pair sex indicators among women by ethnic group.

		Premarital sex %		**Extramarital sex %**		**Average no. sexual partners**	
	Sample size (n ethnic groups)	Pearson Correlation	p value	Pearson Correlation	p value	Pearson Correlation	p value
Mali	9	0.512	0.159	0.439	0.237	0.251	0.515
Senegal	6	0.157	0.766	0.359	0.485	0.504	0.308
Nigeria	10	0.329	0.354	0.126	0.728	-0.036	0.921
Burkina Faso	11	0.308	0.357	0.245	0.467	-0.007	0.983
Ivory Coast	11	-0.753	0.007	-0.789	0.004	-0.593	0.055
All	**47**	**-0.316**	**0.031**	**-0.373**	**0.010**	**-0.379**	**0.009**

Appendix Table 5.5 Results of multilevel logistic regression models examining variables associated with the FGC status of a man's first wife; experimental variables were added to the control variables in separate models; sample restricted to ethnic groups with FGC prevalence 20-80%

CONTROLS	B	S.E.	OR	95% CI	p value
Individual Male SES variables					
Age	0.023	0.004	1.023	(1.015-1.031)	0.000
Religion (other religion/**Muslim**)	0.632	0.082	1.881	(1.602-2.209)	0.000
Rural (urban/**rural**)	0.236	0.077	1.266	(1.089-1.472)	0.002
Age at marriage	-0.023	0.006	0.977	(0.966-0.989)	0.000
Education (none/**some**)	-0.128	0.076	0.880	(0.758-1.021)	0.091
Wealth (increasing 5 point scale)	-0.117	0.029	0.890	(0.840-0.942)	0.000
Polygamous (no/**yes**)	0.060	0.082	1.062	(0.904-1.247)	0.463
Contextual variables					
Ethnic FGC%	0.049	0.005	1.050	(1.040-1.061)	0.000
EXPERIMENTAL VARIABLES					
Proxies for paternity concern: Individual male variables (level 1)					
Model 1. Away last 12 months (no/**yes**)	-0.033	0.064	0.968	(0.853 -1.097)	0.611
Model 2. Away for 1m+ (no/**yes**)	0.069	0.083	1.071	(0.911 -1.261)	0.405
Model 3. Premarital sex (no/**yes**)	0.192	0.074	1.212	(1.048 -1.401)	0.009
Model 4. Extramarital sex (no/**yes**)	0.071	0.114	1.074	(0.859 -1.342)	0.532
Model 5. No. sexual partners in lifetime	0.001	0.004	1.001	(0.993 -1.009)	0.784
Proxies for paternity concern: Ethnic group variables (level 2)					
Model 6. Av. no. sexual partners (men)	0.114	0.025	1.121	(1.067 -1.177)	0.000
Model 7. Av. no. sexual partners (women)	0.760	0.146	2.138	(1.606 -2.847)	0.000
Model 8. Premarital sex % (men)	1.309	0.371	3.702	(1.789 -7.661)	0.000
Model 9. Premarital sex % (women)	1.701	0.377	5.479	(2.617 -11.472)	0.000
Model 10. Extramarital sex % (men)	4.078	0.783	59.027	(12.722 -273.87)	0.000
Model 11. Extramarital sex % (women)	4.118	0.867	61.436	(11.231 -336.07)	0.000

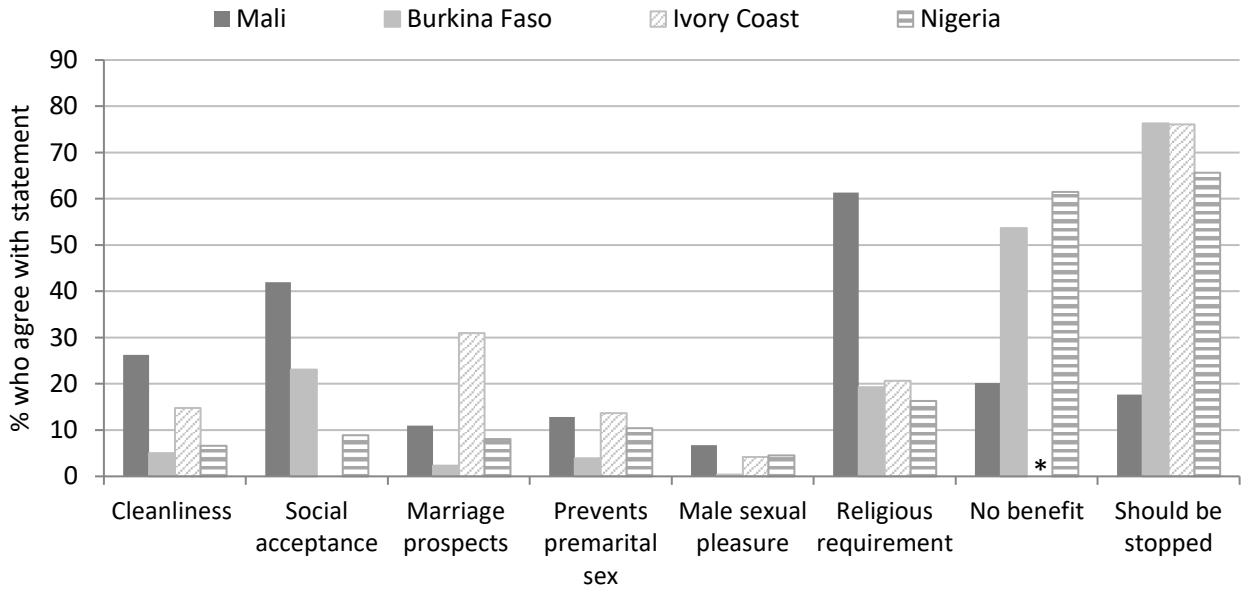
Notes:
Ethnic group n 27, Couples n 6,850
Reference categories for categorical variables are shown in bold

Appendix Table 5.6 Results of multilevel logistic regression models examining variables associated with the FGC status of a man's first wife; experimental variables were added to the control variables in separate models; sample restricted to matrilineal groups

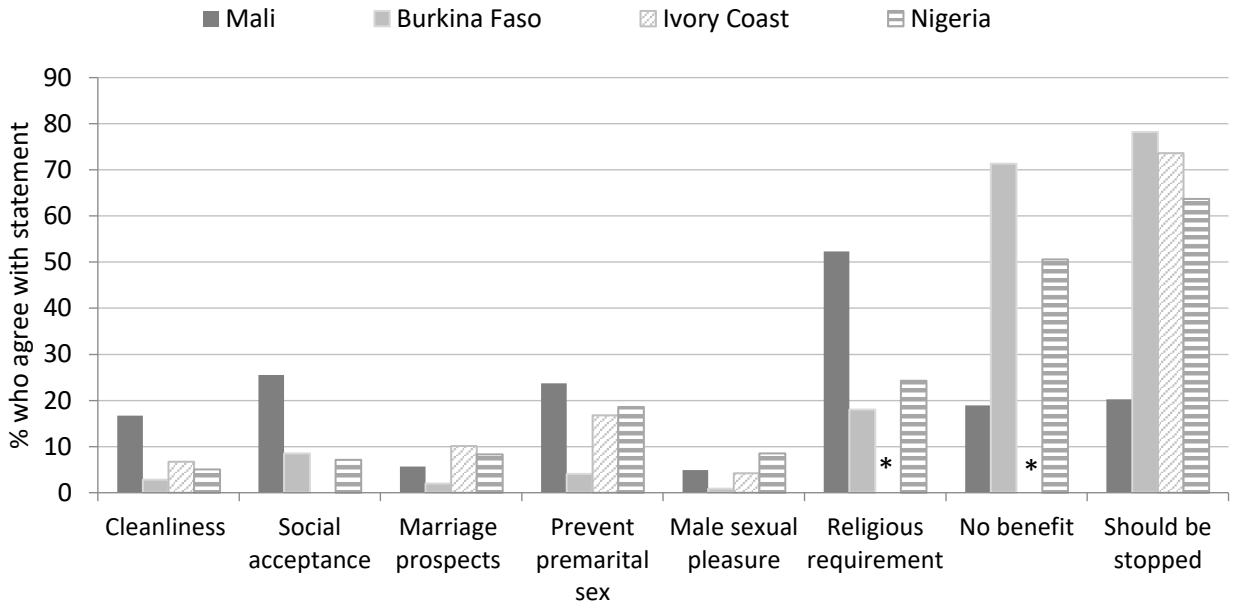
CONTROLS	B	S.E.	OR	95% CI	p value
Individual Male SES variables					
Age	0.031	0.016	1.031	(1.000 -1.064)	0.054
Religion (other religion/**Muslim**)	1.057	0.483	2.878	(1.117 -7.416)	0.000
Rural (urban/**rural**)	0.911	0.480	2.487	(0.971 -6.371)	0.032
Age at marriage	-0.053	0.027	0.948	(0.899 -1.000)	0.052
Education (none/**some**)	0.078	0.372	1.081	(0.521 -2.241)	0.797
Wealth (increasing 5 point scale)	0.128	0.134	1.137	(0.874 -1.478)	0.209
Polygamous (no/**yes**)	0.398	0.377	1.489	(0.711 -3.117)	0.302
Contextual variables					
Ethnic FGC%	0.070	0.015	1.073	(1.041 -1.105)	0.000
EXPERIMENTAL VARIABLES					
Proxies for paternity concern: Individual male variables (level 1)					
Model 1. Away last 12 months (no/**yes**)	0.333	0.297	1.395	(0.779-2.497)	0.263
Model 2. Away for 1m+ (no/**yes**)	-0.247	0.356	0.781	(0.389-1.570)	0.488
Model 3. Premarital sex (no/**yes**)	0.032	0.431	1.033	(0.444-2.403)	0.941
Model 4. Extramarital sex (no/**yes**)	0.080	0.417	1.083	(0.478-2.453)	0.847
Model 5. No. sexual partners in lifetime	0.004	0.011	1.004	(0.983-1.026)	0.703
Proxies for paternity concern: Ethnic group variables (level 2)					
Model 6. Av. no. sexual partners (men)	0.124	0.067	1.132	(0.993-1.291)	0.065
Model 7. Av. no. sexual partners (women)	0.672	0.006	1.958	(1.935-1.981)	0.228
Model 8. Premarital sex % (men)	0.074	0.015	1.077	(1.046-1.109)	0.000
Model 9. Premarital sex % (women)	0.008	0.027	1.008	(0.956-1.063)	0.756
Model 10. Extramarital sex % (men)	0.027	0.019	1.027	(0.990-1.066)	0.142
Model 11. Extramarital sex % (women)	0.033	0.051	1.034	(0.935-1.142)	0.516

Notes:
Ethnic groups n 7, Couples n 639
Reference categories for categorical variables are shown in bold
Ethnic groups included are Tanachek/Touareg (Mali and Burkina Faso),
Lobi (Burkina Faso), Agni, Baoule, Koulango and Guere (Ivory Coast)

Appendix Figure 5.1a Women's opinions about the benefits of FGC



Appendix Figure 5.1b Men's opinions about the benefits of FGC



Notes:

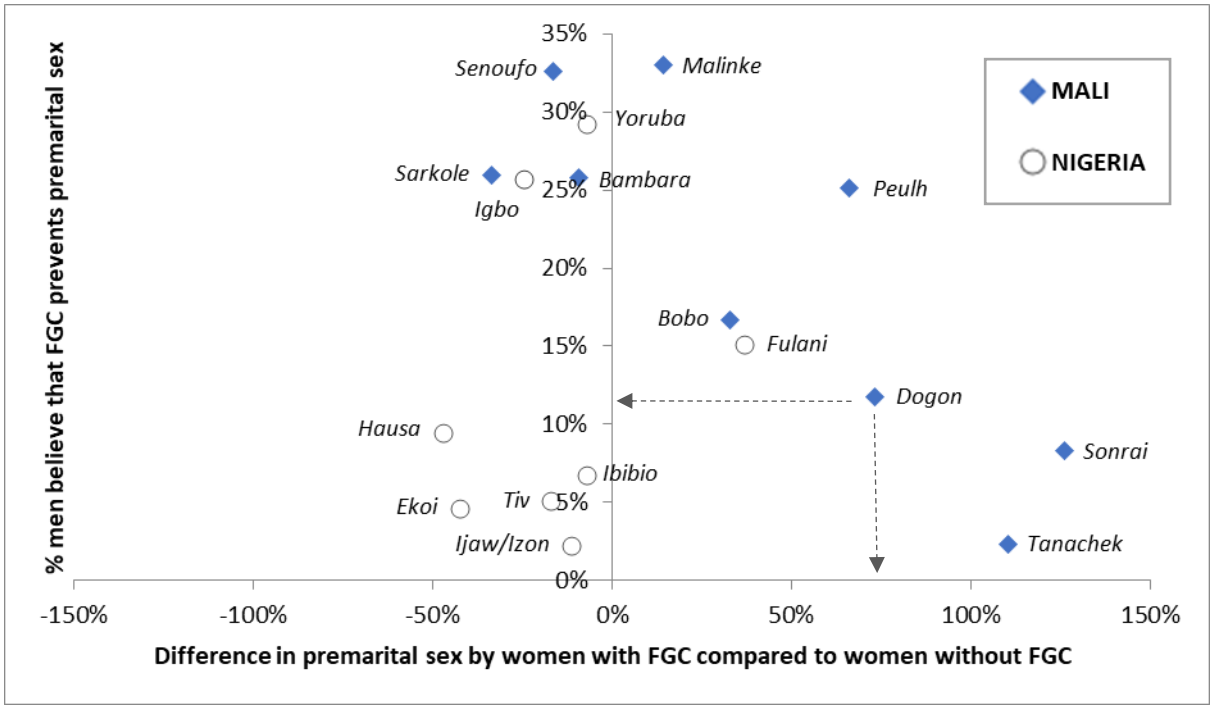
Sample size for 1a (women): Mali n11,740, Burkina Faso n12,037, Ivory Coast n2,264, Nigeria n18.281

Sample size for 1b (men): Mali n3,102, Burkina Faso n12,037, Ivory Coast n767, Nigeria n10,613

* option not included in questionnaire

These charts use different DHS datasets for two countries (Burkina Faso 2003 Phase IV and Ivory Coast 1999 Phase III) as these questions were not included in later surveys used in main analysis.

Appendix Figure 5.2 Comparison of men's beliefs regarding FGC preventing premarital sex and actual incidence of women's premarital sex by FGC status



Notes

Example: 12% of Dogon men believe FGC prevents premarital sex, but 75% more women with FGC than without FGC have had premarital sex

CHAPTER 6 – APPENDICES

Appendix Table 6.1 Single level logistic regression analysis examining predictors of a woman having daughter(s) with FGC estimated by Odds Ratio (OR) and 95% confidence intervals (95% CI)

	Nigeria n 7,916		Burkina Faso n 10,360		Senegal n 6,941		Ivory Coast n 3,241		Mali n 7,792	
	OR (95% CI)	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**
Ethnic FGC %	1.019 (1.014, 1.023)	0.000	1.015 (1.007, 1.023)	0.000	1.012 (1.007, 1.018)	0.000	1.032 (1.020, 1.044)	0.000	1.024 (1.020, 1.028)	0.000
Mother's FGC status	55.334 (47.61, 75.67)	0.000	14.647 (9.260, 23.16)	0.000	94.83 (55.48, 169.76)	0.000	24.199 (14.65, 39.96)	0.000	28.453 (22.016, 37.51)	0.000
Mother's religion	4.040 (3.458, 4.720)	0.000	1.555 (1.368, 1.767)	0.000	0.908 (0.381, 1.786)	0.801	1.654 (1.312, 2.085)	0.000	2.625 (2,117, 3.235)	0.000
Mother's education	0.697 (0.550, 0.785)	0.000	0.562 (0.447, 0.706)	0.000	0.593 (0.463, 0.696)	0.000	0.464 (0.349, 0.616)	0.000	0.876 (0.739, 1.051)	0.138
Mother's age	1.044 (1.035, 1.052)	0.000	1.040 (1.032, 1.047)	0.000	0.984 (0.972, 0.989)	0.000	1.065 (1.053, 1.077)	0.000	1.118 (1.109, 1.128)	0.000
Mother's wealth quintile		0.001		0.000		0.000		0.002		0.002
Poorer	1.306 (1.025, 1.664)	0.055	0.797 (0.676, 0.941)	0.008	1.009 (0.862, 1.266)	0.921	1.262 (0.935, 1.704)	0.128	1.012 (0.853, 1.215)	0.904
Medium	0.982 (0.769, 1.254)	0.758	0.689 (0.582, 0.851)	0.000	0.917 (0.744, 1.113)	0.390	1.252 (0.950, 1.651)	0.110	0.952 (0.791, 1.154)	0.603
Richer	0.971 (0.713, 1.167)	0.797	0.622 (0.525, 0.737)	0.000	0.604 (0.452, 0.787)	0.000	1.039 (0.768, 1.405)	0.804	1.082 (0.911, 1.248)	0.417
Richest	0.647 (0.499, 0.834)	0.069	0.383 (0.207, 0.479)	0.000	0.325 (0.197, 0.527)	0.000	0.674 (0.470, 0.966)	0.032	1.412 (1.133, 1.731)	0.001
OR (95% CI) at increasing ethnic FGC frequencies;										
1%	1.019 (1.014, 1.023)		1.015 (1.007, 1.023)		1.012 (1.007, 1.018)		1.032 (1.020, 1.044)		1.024 (1.020, 1.028)	
50%	2.454 (2.041, 3.171)		2.119 (1.451, 3,094)		1.868 (1.384, 2.340)		4.729 (1.101, 8.491)		3.225 (2.699, 3.928)	
100%	6.472 (4.162, 10.05)		4.490 (2.105, 9.573)		3.488 (1.914, 5.472)		22.367 (6.937, 72.10)		10.401 (7.286, 15.48)	

Notes

Reference category underlined:

Mother's FGC status: No FGC, FGC

Mother's religion: Christian or other, Muslim

Mother's education: No education, Some education

Mother's wealth: Poorest, Poorer, Medium, Richer, Richest

Appendix Table 6.2 Multilevel logistic regression analysis examining predictors of a woman having daughter(s) with FGC estimated by Odds Ratio (OR) and 95% confidence intervals (95% CI)

	Model 1		Model 2		Model 3	
Parameter	**OR (95% CI))**		**OR (95% CI)**		**OR (95% CI)**	
Fixed effects						
Mother's FGC status (No)						
Yes			32.201 (24.85, 40.98)	***	31.66 (24.85, 40.33)	***
Mother's education (None)						
Some (primary or above)			0.763 (0.695, 0.838)	***	0.762 (0.694, 0.836)	***
Mother's religion (Christian/other)						
Muslim			1.692 (1.534, 1.906)	***	1.711 (1.540, 1.900)	***
Mother's wealth quintile (lowest)						
Second			0.967 (0.877, 1.067)	ns	0.966 (0.876, 1.064)	ns
Third			0.839 (0.798, 0.883)	**	0.836 (0.757, 0.923)	*
Fourth			0.766 (0.725, 0.808)	***	0.762 (0.687, 0.847)	***
Fifth			0.618 (0.549, 0.695)	***	0.619 (0.583, 0.658)	***
Mother's age (years)			1.052 (1.047, 1.058)	***	1.052 (1.046, 1.057)	***
Contextual factors						
Ethnic FGC frequency (%)				***	1.022 (1.015, 1.029)	***
Random effects						
Ethnic group variation	10.870 (3.684, 32.072)	***	1.690 (1.310, 2.181)	***	1.274 (1.121, 1.445)	***
Country variation	4.092 (0.479, 34.953)	ns	4.191 (0.651, 26.950)	ns	3.717 (0.702, 19.69)	ns
Variance Analysis						
Ethnic group level (Level 2)						
Variance (SE)	2.386 (0.553)		0.525 (0.131)		0.241 (0.064)	
Explained variation (%)	Reference		78.0		89.9	
ICC (%)	42.0		13.8		6.8	
MOR	4.34		1.99		1.59	
Country level (Level 3)						
Variance (SE)	1.409 (0.097)		1.433 (0.946)		1.313 (0.848)	
Explained variation (%)	Reference		-1.7		6.8	
ICC (%)	19.9		27.3		27.1	
MOR	3.09		3.12		2.97	

* p<0.05 ** p <0.01 *** p < 0.001 ns p>0.05

ICC - Intra-cluster correlation, MOR - median odds ratio

Model 1: Null model without any exposure variable

Model 2: Adjusted for individual variables (mother's FGC status, education, age, religion and wealth)

Model 3: Additionally adjusted for level 2 contextual variable, ethnic FGC frequency (%)

Appendix Table 6.3 Pearson's correlation between ethnic FGC Frequency (%) and the percentage difference in average number of surviving offspring for women aged 40-49 in each ethnic group with FGC compared to women without FGC – excluding women who have been infibulated

COUNTRY	Ethnic Groups n	EXCLUDING INFIBULATED WOMEN		
		Women n	Pearson's R	p value
Mali	6	1,514	0.905	0.013
Ivory Coast	9	827	0.860	0.003
Nigeria	8	3,128	0.775	0.024
Burkina Faso	8	2,549	0.448	0.227
Senegal	7	1,989	0.743	0.057

Appendix Table 6.4 Statistical comparison of adult height, and infant and child mortality between women aged 40-49 years with and without FGC.

COUNTRY	FGC STATUS	n	ADULT HEIGHT		INFANT AND CHILD MORTALITY a)							
			Mean height cm + 1d (SD, SE)	T value	Mortality at 1 month				Mortality at 1-5 years			
					Male children		Female children		Male children		Female children	
					n	%	n	%	n	%	n	%
Mali	No FGC	265	1613.2 (66.0 , 4.06)	**-0.68**	613	6.4	592	5.1	594	23.9	516	20.2
	FGC	1,946	1616.0 (62.1 , 1.41)		4,807	7.7	4,516	6.3	4,279	24.0	3,998	21.9
					OR 1.32 (0.93, 1.86)		**OR 1.23 (0.83, 1.81)**		**OR 1.06 (0.86, 1.31)**		**OR 1.09 (0.87, 1.38)**	
Ivory Coast	No FGC	361	1587.7 (58.4 , 3.08)	**-0.62**	1,526	5.3	1,585	4.8	1,397	12.7	1,428	10.4
	FGC	345	1590.6 (61.0 , 3.28)		1,685	6.2	1,582	6.4	1,505	16.0	1,425	14.3
					OR 1.10 (0.81, 1.51)		**OR 1.43 (1.01 ,1.96) ***		**OR 1.21 (0.97, 1.51)**		**OR 1.34 (1.06, 1.69) ***	
Nigeria	No FGC	1,382	1594.8 (71.0 , 1.19)	**0.97**	3,547	6.2	3,401	4.9	3,160	16.6	3,913	14.3
	FGC	1,676	1592.4 (67.7 , 1.65)		4,284	5.9	4,149	3.9	3,019	16.3	3,778	13.3
					OR 0.98 (0.81, 1.19)		**OR (0.81 (0.65, 1.01)**		**OR 0.91 (0.80, 1.04)**		**OR 0.90 (0.78, 1.03)**	
Burkina Faso	No FGC	162	1611.0 (63.2 , 4.96)	***-2.01**	751	4.8	736	3.4	669	16.7	651	14.4
	FGC	1,224	1620.9 (58.5 , 1.67)		6,291	4.5	6,128	4.2	5,660	16.1	5,486	16.6
					OR 0.91 (0.64, 1.30)		**OR 1.23 (0.81, 1.87)**		**OR 0.92 (0.74, 1.14)**		**OR 1.14 (0.90, 1.43)**	
Senegal	No FGC	482	1640.1 (64.3 , 2.93)	***5.11**	2,697	4.6	2,624	3.4	2,391	11.0	2,359	10.0
	FGC	307	1616.4 (68.1 , 3.48)		1,982	6.4	2,258	4.2	1,753	17.4	1,621	13.9
					OR 1.37 (1.05, 1.78) *		**OR 1.42 (1.04, 1.96) ***		**OR 1.52 (1.26, 1.82)***		**OR 1.25 (1.03, 1.53) ***	

*p<0.05, **p<0.01, ***p<0.001

a) Odds Ratios (OR) are shown here with 95% confidence intervals are the result of multivariate logistic analysis for the variables mother's FGC status (reference; not cut) as a predictor of child mortality when controlling for wealth (quintiles) and education (no education/some education).

Appendix Table 6.5 Inclusion criteria for countries in West Africa

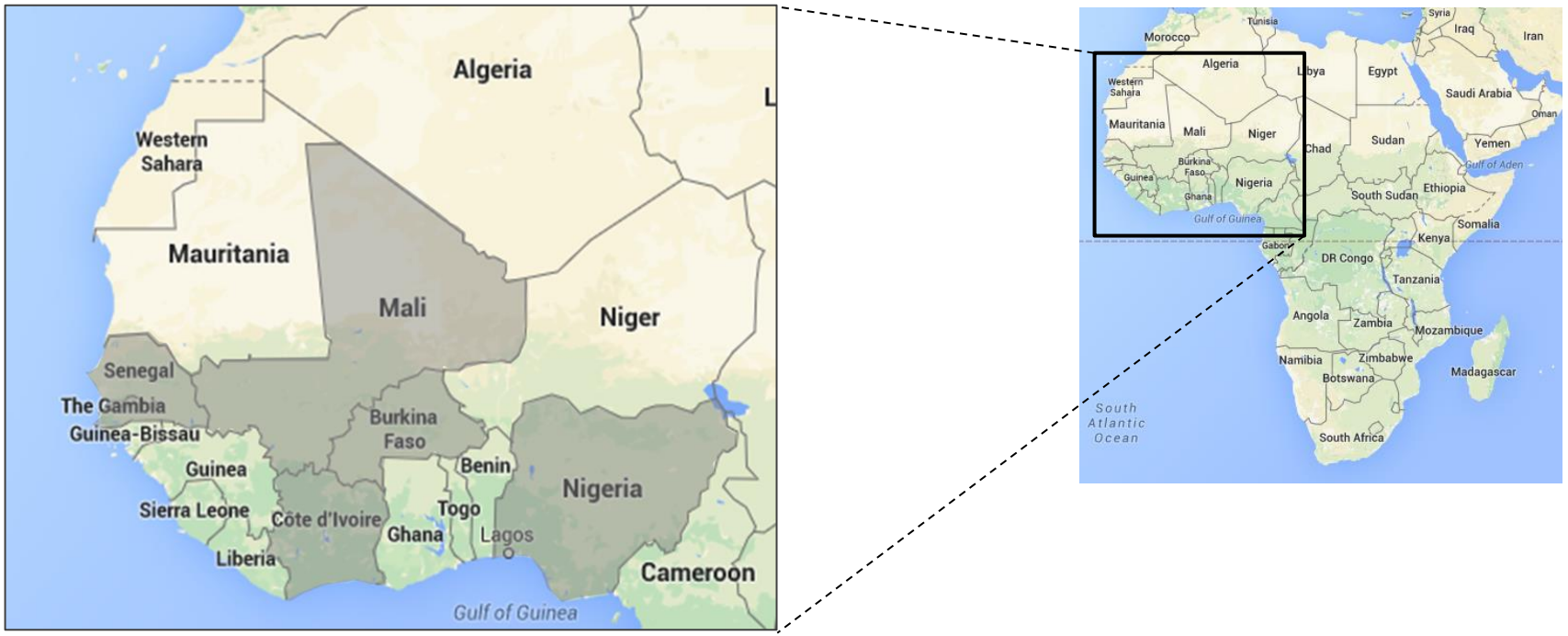
COUNTRY	CURRENT POPULATION [a]	COUNTRY FGC PREVALENCE [b]	DHS SURVEY					INCLUSION SUITABILITY
			DATE	WOMEN n	FGC PREVALENCE	NO. ETHNIC GROUPS [c]	RANGE IN FGC PREVALENCE	
NIGERIA	177.2m	27%	2008	33,385	46%	10	1 – 70%	**Suitable**
ALGERIA	38.8m	-	No DHS survey					n/a
GHANA	25.7m	4%	2003	5,691	9%	8	0 - 27%	FGC is the minority behavior in all ethnic groups, therefore not suitable.
IVORY COAST	22.8m	38%	2012	10,060	44%	11	2 – 71%	**Suitable**
BURKINA FASO	18.4m	76%	2010	17,087	76%	10	27 – 85%	**Suitable.**
MALI	16.5m	89%	2006	14,583	87%	9	36 – 98%	**Suitable**
NIGER	17.5m	2%	2012	11,160	4%	Not available	Not available	FGC by ethnic group not available, therefore not suitable.
SENEGAL	13.6m	26%	2010	15,688	40%	6	2 - 87%	**Suitable**.
GUINEA	11.5m	96%	2012	9,142	98%	6	70 – 100%	FGC is the majority behaviour in all ethnic groups, therefore not suitable.
BENIN	10.2m	13%	2012	6,599	12%	8	0 – 51%	Only one ethnic group has over 50% and is small (n 532), therefore not suitable.
TOGO	7.3m	4%	2013	9,480	9%	5	0 – 9%	FGC is the minority behaviour in all ethnic groups, therefore not suitable.
SIERRA LEONE	5.7m	88%	2013	16,658	90%	9	85 – 95%	FGC is the majority behaviour in all ethnic groups, therefore not suitable.
LIBERIA	4.1m	66%	DHS survey does not include FGC module					n/a
MAURITANIA	3.5m	69%	DHS data not available					n/a

a Source: CIA World Fact Book July 2014 estimate

b Source: United Nations Children's Fund, Female Genital Mutilation/Cutting: A statistical overview and exploration of the dynamics of change, UNICEF, New York, 2013.

c This excludes non-nationals and smaller ethnic groups identified as 'other'

Appendix Figure 6.1 Map of countries in West Africa included in the study



Source: Google Maps

Key: Countries shaded in grey are included in the study (Mali, Burkina Faso, Nigeria, Senegal and Ivory Coast)

Appendix Table 6.6 FGC frequency by country and ethnic group

COUNTRY	ETHNIC GROUP	All Women aged 15-49 years		Women aged 40-49 years		FGC status of daughters	
		n	% FGC	n	% FGC	n	% FGC
NIGERIA	Tiv	298	1.0	58	0.0	201	0.5
	Kanuri/Beri	538	1.1	99	1.0	355	2.3
	Igala	92	2.2	24	4.2	52	1.9
	Fulani	606	20.3	117	16.2	398	17.6
	Ibibio	506	21.9	85	41.2	272	5.5
	Ijaw/Izon	1,044	27.7	171	50.3	531	9.8
	Hausa	2,443	38.1	505	39.0	1,659	35.1
	Ekoi	486	42.0	84	63.1	254	9.8
	Igbo	4,027	62.3	790	77.7	1,939	32.9
	Yoruba	4,211	70.5	810	75.3	2,255	47.1
	TOTAL	**14,251**	**45.8**	**2,743**	**58.9**	**7,916**	**31.0**
MALI	Sonrai	1,010	35.6	191	41.9	601	26.0
	Tanachek	379	40.1	70	35.7	225	29.8
	Bobo M	286	69.2	58	81.0	169	34.3
	Dogon	1,294	83.3	292	80.5	844	70.6
	Senoufo/Minianka	1,272	95.0	194	94.8	759	69.7
	Peulh	1,883	95.7	340	95.6	1,149	76.8
	Sarkole/Soninke/Marka	1,659	97.4	284	99.3	1,051	91.7
	Malinke M	1,072	98.1	185	98.4	665	86.2
	Bambara	3,550	98.3	589	97.1	2,171	77.2
	TOTAL	**12,405**	**88.6**	**2,203**	**87.7**	**7,634**	**72.0**
BURKINA FASO	Toureg/Bella	254	27.6	43	34.9	155	5.2
	Gourounsi	790	55.8	122	71.3	488	9.2
	Gourmatche	1,045	62.2	134	80.6	736	9.1
	Bobo BF	644	66.9	109	85.3	404	14.6
	Dagara	560	69.3	130	95.4	359	17.3
	Diola BF	155	69.7	33	90.9	106	11.3
	Mossi	8,912	78.0	1,543	90.0	5,653	13.4
	Bissa	672	82.3	105	96.2	410	17.8
	Lobi	617	84.4	133	97.0	427	17.3
	Senoufo BF	906	85.1	154	95.5	619	16.8
	Fulfulde/Peul	1,346	85.4	234	91.9	949	26.8
	TOTAL	**15,901**	**75.7**	**2,740**	**89.0**	**10,306**	**14.7**
SENEGAL	Wolof	4,553	2.0	713	2.9	2,374	0.6
	Serer	1,653	4.1	279	6.1	893	0.4
	Diola SN	659	59.5	89	56.2	287	20.9
	Poular	4,675	69.4	701	73.9	2,668	31.2
	Soninke SN	354	76.3	52	82.7	158	25.3
	Mandingue	1,014	90.0	140	90.7	561	39.6
	TOTAL	**12,908**	**39.3**	**1,974**	**39.3**	**6,941**	**16.9**
IVORY COAST	Bete	264	0.8	49	2.0	120	0.0
	Agni	557	1.4	98	0.0	288	0.0
	Baoule	1,603	3.5	281	6.4	873	0.2
	Koulango	336	16.4	60	25.0	172	4.1
	Gouro	218	33.0	38	42.1	123	9.8
	Guere	204	39.7	34	76.5	111	1.8
	Yacouba	427	67.7	66	90.9	223	9.4
	Dioula IC	273	70.7	54	81.5	182	25.8
	Malinke IC	696	71.6	114	82.5	373	24.7
	Kayaka	329	72.0	61	83.6	186	32.3
	Senoufo IC	1,111	78.2	162	88.9	590	26.6
	TOTAL	**6,018**	**39.2**	**1,017**	**46.1**	**3,241**	**12.3**
TOTAL		**61,483**	**58.8**	**10,677**	**67.7**	**36,038**	**30.6**

CHAPTER 7 – APPENDICES

Appendix Table 7.1. Summary of studies using multivariate logistic regression analysis to examine men's self-reported IPV behaviour in low and middle income countries

Reference	Country	Sample size	IPV type and prevalence		INDIVIDUAL														COUPLE							COMMUNITY	
			Physical	Sexual	Socioeconomic profile					Childhood experience		Behaviour/adult experiences				Attitude	Health										
			L = lifetime T = past 10 years Y = past year C = with current partner		**Poverty/ economic stress**	Young age at first marriage	Low/high education	In employment	Age (i.e. older man)	Adverse childhood experience e.g. abuse, trauma, neglect	Witnessing parental violence in childhood	Involved in violence or gangs with other men	**Pre/extra marital sex, multiple sexual partners**	Drug or alcohol use / abuse	Transactional sex	Inequitable gender attitudes, IPV justified	STI or HIV+	PTSD, depression, poor mental health	Relationship conflict, instability	**Conflict due to female infidelity**	**Conflict due to male infidelity**	Marital difference (e.g. in age/education)	Years married	Multiple children	Childlessness	Community norms of IPV	Community violence
(Hoffman et al., 1994)	Thailand	619	**L** 20 %	..	**X**	..	..	n/s	..	..	..	..	..	n/s	..	..	..	n/s	**X**	..	..	n/s	n/s	n/s	..	..	..
(Martin et al., 1999)	India: 5 districts	6,156	18-45% **L** (analysis IPPV only)	**L** 4-40%	**X**	**V**	**X** (-)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**V**	**V**	n/s	..	..
(Martin et al., 2002)	India	6,902	26% **L**	..	**X**	..	**X** (-)	..	n/s	..	**X**	..	..	..	..	..	..	..	..	..	..	..	n/s	n/s	..	..	..
			..	51% **L**	**X**	..	n/s	..	n/s	..	**X**	..	..	..	..	..	..	..	..	..	..	..	n/s	n/s	..	..	..
(Abrahams et al., 2004a)	South Africa	1,368	..	15% **T** [a]	..	..	n/s	..	n/s	n/s	n/s	**X**	**X**	**X**	..	**X**	..	..	**X** [b]	..	..	..	..	..	..	..	..
(Abrahams et al., 2006)	South Africa	1,378	42% T 9% Y	..	..	..	**X** (-)	..	..	n/s	n/s	n/s	**X**	**X X**	..	**X**	..	..	**X**	..	**X**	..	..	..	..	..	..
(Dunkle et al., 2006)	South Africa	1,275	22.9% Y		..	..	..	..	..	..	..	**X**	**X**	**X X**	**X**	..	..	..	..	..	..	..	..	..	..	..	..
				3.6% Y	..	..	..	..	..	..	..	**X**	**X**	**X** n/s	**X**	..	..	..	..	..	..	..	..	..	..	..	..	..
(Koenig et al., 2006)	India	4,520	**25.1% Y** 31.8% L		**X**	..	**X** (-)	..	..	..	**X**	..	**X**	..	..	..	..	..	..	..	..	..	**X** (+)	..	**X**	**X**	**X**
				30.1% Y 34.1% L	**X**	..	**X** (+)	..	..	..	**X**	..	**X**	..	..	..	..	..	..	..	..	..	n/s	..	**X**	n/s	**X**
(Silverman et al., 2007)	Bangladesh [c]	3,096	20.5% Y (Both: 7.7%)		n/i	n/i	n/i	n/i	n/i	..	..	..	**X X**	..	..	..	**X**	..	..	..	..	..	..	..	..	..	..
				9.5% Y	n/i	n/i	n/i	n/i	n/i	..	..	..	**X X**	..	..	..	**X**	..	..	..	..	..	..	..	..	..	..
(Aklimunnessa et al., 2007)	Bangladesh [c]	3,165	68% Y (Any IPV:72%)	27% Y	..	..	..	..	..	..	..	..	**X**	**X**	..	..	**X**	..	..	..	..	..	..	..	..	..	..
(Gupta et al., 2008)	South Africa	834	28% C	..	n/s		n/s	n/s	n/s	**X**	**X**	..	..	..	..	..	..	..	**X** [g]	..	..	..	..	**X** [d]	..	..	..

Reference	Country	Sample size	IPV type and prevalence		INDIVIDUAL														COUPLE								COMMUNITY	
			Physical	Sexual	Socioeconomic profile					Childhood experience		Behaviour/adult experiences				Attitude	Health											
			L = lifetime T = past 10 years Y = past year C = with current partner		**Poverty/ economic stress**	Young age at first marriage	Low/high education	In employment	Age (i.e. older man)	Adverse childhood experience e.g. abuse, trauma, neglect	Witnessing parental violence in childhood	Involved in violence or gangs with other men	**Pre/extra marital sex, multiple sexual partners**	Drug or alcohol use / abuse	Transactional sex	Inequitable gender attitudes, IPV justified	STI or HIV+	PTSD, depression, poor mental health	Relationship conflict, instability	**Conflict due to female infidelity**	**Conflict due to male infidelity**	Marital difference (e.g. in age/education)	Years married	Multiple children	Childlessness	Community norms of IPV	Community violence
(Pulerwitz and Barker, 2008)	Brazil [e]	223	31% C	..	..	..	..	..	..	..	..	..	..	..	..	**X**	..	..	..	..	..	..	..	..	..	..	..	..
(Sambisa et al., 2010)	Bangladesh	1,508	55% L (23% Y)		**X**	..	**X** [f]	n/s	**X**	..	..	..	..	**X**	..	**X**	n/s	**X**	..	..	..	..	..	..	..	..	..	..
				20% L	**X**	..	n/s	n/s	n/s	..	..	..	..	**X**	..	**X**	**X**	n/s	..	..	..	..	..	..	..	..	..	..
(Townsend et al., 2011)	South Africa	430	36% Y		..	..	..	..	..	..	..	..	n/s	**X**	..	..	**X**	..	..	**X**	..	..	..	..	..	..	..	..
				18.9% Y	..	..	..	..	..	..	..	..	**X**	ns	..	..	**X**	..	..	**X**	..	..	..	..	..	..	..	..
(Fulu et al., 2013)	9 countries Asia & Pacific	10,178	6 - 45% L (Both: 4-41%)	..	**X**	..	**X** (-)	..	..	**X**	..	**X**	..	**X**	..	..	..	**X**	..	..	..	..	..	..	..	..	..	**X**
				3 – 22% L	n/s	..	n/s	..	..	**X**	..	n/s	..	**X**	..	..	..	n/s	..	..	..	..	..	..	..	..	..	n/s
(Fleming et al., 2015)	8 countries (IMAGES)	7,806	31% (range 17-45%) L	..	**X**	..	n/s	n/s	**X**	..	**X**	**X**	..	..	..	**X**	..	..	..	..	..	..	..	..	..	..	..	
(Barker et al., 2015)	8 countries	8,000	17-39% L		**X**	..	**X** (-)	..	**X** (-)	..	**X**	..	..	**X**	..	**X**	..	..	..	..	..	..	..	..	..	..	**X**	..
				25% (range 6-29%) L	n/s	..	n/s	..	n/s	..	**X**	..	..	**X**	..	**X**	..	..	..	..	..	..	..	..	..	..	n/s	..
(Fonseka et al., 2015) **	Sri Lanka	1,252	21.9% L Any: 49.3%		n/i	n/i	n/i	n/i	n/i	**X X**	**X**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
				13.7% L	n/i	n/i	n/i	n/i	n/i	**X X**	n/s	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
(Machisa et al., 2016)	South Africa	416	Any IPV 44% L		..	..	..	**X**	..	**X**	..	..	..	..	..	..	..	**X**	..	..	..	..	..	..	..	..	..	..
(Peitzmeier et al., 2016)	USA, India, China, South Africa	2,013	any IPV 9-40% Y		..	..	**V**	**V**	**V**	**X**	..	**X**	..	**X**	..	..	..	**X**	..	..	..	..	..	..	..	..	..	..
(VanderEnde et al., 2016)	Malawi	450	9% L		..	..	..	..	..	**X** [h]	..	n/s	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	n/s
				24% L	..	..	..	..	..	**X** [i]	..	**X**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	n/s

Reference	Country	Sample size	IPV type and prevalence		INDIVIDUAL													COUPLE							COMMUNITY	
			Physical	Sexual	Socioeconomic profile					Childhood experience		Behaviour/adult experiences				Attitude	Health									
			L = lifetime T = past 10 years Y = past year C = with current partner		**Poverty/ economic stress**	Young age at first marriage	Low/high education	In employment	Age (i.e. older man)	Adverse childhood experience e.g. abuse, trauma, neglect	Witnessing parental violence in childhood	Involved in violence or gangs with other men	**Pre/extra marital sex, multiple sexual partners**	Drug or alcohol use / abuse	Transactional sex	Inequitable gender attitudes, IPV justified	STI or HIV+	PTSD, depression, poor mental health	Relationship conflict, instability	**Conflict due to female infidelity**	**Conflict due to male infidelity**	Marital difference (e.g. in age/education)	Years married	Multiple children	Childlessness	Community norms of IPV	Community violence
(Yount et al., 2016)	Vietnam	522	28% L any IPV [j]	0.2%	n/s	..	..	..	n/s	**X**	**X**	..	..	..	..	**X**	..	..	..	..	..	**X**	..	n/s	..	**X**	..
(Akhter and Wilson, 2016)	Bangladesh	3,339	**74% L** (37% Y)	..	**X**	..	**X** (-)	..	**X**	..	..	..	..	n/s	..	n/s	..	..	..	n/s	**X**	..	..	..	..	..	..
(Teitelman et al., 2017)	South Africa	871	Any IPV 21.8% Y		..	..	n/s	**X**	..	**X**	..	..	..	**X**	..	..	..	..	**X**	..	..	**X**	..	..	..	..	..
(Gilchrist et al., 2017)	Brazil/England	281/223	46.4% L	11.6% L	..	..	..	..	..	**X**	..	**X**	..	**X**	..	..	..	**X**	..	..	..	..	..	..	..	..	..
(Yount et al., 2018)	Bangladesh	1,508	50% L		**X**	..	**X** (-)	..	**X**	**X**	**X**	..	..	..	..	**X**	..	..	..	..	..	**X**	..	**X**	..	**X**	..
(Chirwa et al., 2018) **	Ghana	2,126	(27.7% L) 25.0% Y	(27.8% L) 16.6% Y	n/s	..	..	n/s	n/s	**X**	**X**	..	**X**	**X**	**X**	**X**	..	n/s	n/s	..	..	n/s	..	..	..	..	..
(Machisa and Shamu, 2018)	Zimbabwe	2,838	56% L	31%	..	..	..	..	**X**	**X**	..	..	**X**	**X**	..	**X**	..	**X**	..	..	..	..	..	..	..	..	..

Notes

[a] 80.9% of men reporting sexual IPV also reported physical IPV during the same period.

[b] Specifically conflict over sexual refusal and conflict where men perceived their authority to be undermined

[c] Both these studies used Bangladesh DHS datasets from 2004 survey – it is unclear how they have such different estimates of IPV prevalence.

[d] Having 1-2 children (compared to no children, or 3+ children) was associated with men's use of IPPV

[e] Factor analysis not logistic regression

[f] IPPV significantly associated with primary education, rather than no education or secondary education

[g] Being separated or divorced associated with IPPV

[h] Physical and emotional childhood abuse is significantly associated with IPPV

[i] Sexual and emotional childhood abuse is significantly associated with IPSV

[j] Includes physical, psychological and sexual IPV

** study captured frequency of IPV, not just binary response

x = variable significant in multivariate logistic regression

v = significance of variable varied in multi-country study

n/s = variable not significant in multivariate logistic regression

n/I = variable included in model but no information on significance provided

.. = variable not included in the multivariate logistic regression model

Appendix Table 7.2 Matching DHS ethnic groups with Bantu Guthrie groups using Glottolog language codes

DHS group name	Glottolog language	Bantu?	Guthrie Zone	Guthrie Code	Glottocode	ISO code	Duplicate?	Usable?
KENYA								
Kikuya	Kikuyu	Yes	E	E51	kiku1240	639-3 kik		yes
Kalenjin	Kalenjin	No	n/a - Nilotic, Southern Nilotic		kale1246	-		no
Luhya	Luyia / Luhyia	Yes	JE	JE32	luyi1234	-		yes
Luo	Luo	No	n/a - Nilotic, Western Nilotic		luok1236	-		no
Kamba	Kamba	Yes	E	E55	kamb1297	639-3 kam		yes
Somali	Somali	No	n/a - Afro-Asiatic, Cushitic		soma1255	-		no
Kisii	Gusii	Yes	JE	JE42	gusi1247	639-3 guz		yes
Meru	Mero	Yes	E	E53	meru1245	639-3 mer		yes
Mijikenda/ Swahili	Swahili	Yes	G	G40	swah1253	639-3 swh	mixed	no
	Mijikenda	Yes	E	E72	miji1238	-		
Samburu	Samburu	No	n/a - Nilotic, Eastern Nilotic		samb1315	639-3 saq		no
Turkana	Turkana	No	n/a - Nilotic, Eastern Nilotic		turk1308	639-3 tuv		no
Maasai	Masai	No	n/a - Nilotic, Eastern Nilotic		masa1300	639-3 mas		no
MALAWI								
Chewa	Chewa-Nyanja, Chichewa	Yes	N	N31	nyan1308	639-3 nya	Yes (Zam, Moz)	yes
Tumbuka	Tumbuka	Yes	N	N21	tumb1250	639-3 tum	Yes (Zam)	yes
Lomwe	Malawi Lomwe	Yes	P	P331	mala1256	639-3 lon		yes
Tonga	Tonga	Yes	N	N15	tong1321	639-3 tog		yes
Yao	Yao	Yes	P	P21	yaoo1241	639-3 yao	Yes (Moz)	yes
Sena	Sena-Malawi	Yes	N	N441	mala1475	639-3 swk		yes
Ngoni	Ngoni - Malawi	Yes	N	N121	mand1475	-	Yes (Zam)	yes
Mang'anja	Nyanza	Yes	N	N31c	mang1391	-		yes
ZAMBIA								
Bemba	Bemba	Yes	M	M42	bemb1257	639-3 bem		yes
Tonga	Tonga	Yes	M	M64	tong1318	639-3 toi		yes
Chewa	Chewa-Nyanja, Chichewa	Yes	N	N31	nyan1308	639-3 nya	Yes (Mal, Moz)	yes
Lozi	Lozi	Yes	K	K21	lozi1239	639-3 loz		yes
Nsenga	Nsenga, Cinsenga,	Yes	N	N41	nsen1242	639-3 nse	Yes (Moz)	yes
Tumbuka	Tumbuka	Yes	N	N21	tumb1250	639-3 tum	Yes (Mal)	yes
Ngoni	Ngoni - Malawi	Yes	N	N121	mand1475	-	Yes (Mal)	yes
Kaonde	Kaonde	Yes	L	L41	kaon1241	639-3 kqn		yes
Mambwe	Mambwe	Yes	M	M15	mamb1296	639-3 mgr		yes
Namwanga	Nyamwanga	Yes	M	M22	nyam1257	639-3 lun		yes
Lunda (north-eastern)	Lunda	Yes	L	L52	nyam1275	639-3 mwn		yes
Luvale	Lwena	Yes	K	K14	luva1239	639-3 lue		yes
Lala	Lala-Bisa	Yes	M	M51/2	lala1264	639-3 leb	Yes (Zam)	yes
Lamba	Lamba	Yes	M	M54	lamb1271	639-3 lam		yes
Ushi	Aushi, Asi (Bemba)	Yes	M	M40	aush1241	639-3 auh		yes
Mbunda	Mbunda	Yes	K	K15	mbun1249	639-3 mck		yes
Lenje	Lenje	Yes	M	M61	lenj1248	639-3 leh		yes
Bisa	Lala-Bisa	Yes	M	M51/2	lala1264	639-3 leb	Yes (Zam)	yes

Appendix Table 7.2 Matching DHS ethnic groups with Bantu Guthrie groups using Glottolog language codes (contd.)

DHS group name	Glottolog language	Bantu?	Guthrie Zone	Guthrie Code	Glottocode	ISO code	Duplicate?	Usable?
CAMEROON								
Arab-Choa/Peulh/Haoussa/Kanuri	Mixed	No	n/a - mixed					no
Biu-Mandara	Biu-Mandara	No	n/a - Afro-Asiatic, Chadic		bium1280	-		no
Adamaoua-Oubangui	Ubangi	No	n/a - Atlantic-Congo, Volta-Congo		uban1244	-		no
Grassfields	Grassfields	No (sister group)	n/a - Atlantic-Congo, Volta-Congo		wide1239	-		no
Bamilike/Bamoun	Grassfields	No (sister group)	n/a - Atlantic-Congo, Volta-Congo		wide1240	-		no
Côtier/Ngoe/Oroko	Cotier	?	?					no
	Ngoe (Mbo)	Yes	A	A15	mboc1235	639-3 mbo		
	Oroko	Yes	A	A101	orok1266	639-3 bdu		
Beti/Bassa/Mbam	Beti (Ewondo)	Yes	A	A72	ewon1239	639-3 ewo		yes
	Bassa (Basaa)	Yes	A	A43	basa1284	639-3 bas		
	Mbam	Yes	A	A40/A60	mbam1252	-		
Kako/Meka/Pygmé	Kako	Yes	A	A93	kako1242	639-3 kkj		no
	Meka (Afade, Bui-Mandara)	No	n/a - Afro-Asiatic, Chadic		bium1280	-		
	Pygme (Ubangi)	No	n/a - Atlantic-Congo, Volta-Congo		uban1244	-		
DEMOCRATIC REPUBLIC OF CONGO								
Bakongo Nord & Sud	Kikongo / Lingala	Yes	H	H10/H16				yes
Bas-Kasai et Kwilu-Kwngo	Bas-Kasai (Luba-Kasai)	Yes	L	L31a	luba1253	-		no
	Kwilu-Kwngo (?)	?						
Cuvette central	? Congo basin/pygmy?	?						no
Ubangi et Itimbiri	? Bangi	? Yes	C	C32				yes
Uele Lac Albert	?	?						no
Basele-K , Man. et Kivu	?	?						no
Kasai, Katanga, Tanganika	Kasai (Bushoong)	Yes	C	C83	bush1247	639-3 buf		no
	Katanga	?						
	Tanganika	?						
GABON								
Fang	Fang	Yes	A	A75	fang1246	639-3 fan		yes
Kota-Kele	Kota	Yes	B	B25	kota1274	639-3 koq		yes
Mbede-Teke	Mbere/Mbete	Yes	B	B60	mber1257	639-3 mdt		yes
Myene	Myene	Yes	B	B11	myen1241	639-3 mye		yes
Nzabi-Duma	Nzabi (Nzebi)	Yes	B	B51	njeb1244	-		yes
	Duma	Yes	B	B53	duma1253	639-3 dma		
Okande-Tsogho	Okande (Kande)	Yes	B	B32	kand1300	639-3 kbs		yes
	Tsogho (Tsogo)	Yes	B	B31	tsog1243	639-3 tsv		
Shira-Punu/Vili	Sira	Yes	B	B41	sira1266	639-3 swj		yes
	Punu	Yes	B	B43	punu1239	639-3 puu		
	Vili (Nzebi)	Yes	B	B51	njeb1244	-		

Appendix Table 7.2 Matching DHS ethnic groups with Bantu Guthrie groups using Glottolog language codes (contd.)

DHS group name	Glottolog language	Bantu?	Guthrie Zone	Guthrie Code	Glottocode	ISO code	Duplicate?	Usable?
MOZAMBIQUE								
Emakhuwa	Makhuwa, Emakhuwa, Makua	Yes	P	P31	makh1246	639-3 vmw		yes
Português	n/a							
Xichangana	Changana, Tsonga	Yes	P	P53	tson1249	639-3 tso		yes
Cisena	Nsenga, Cinsenga,	Yes	N	N41	nsen1242	639-3 nse	Yes (Zam)	yes
Elomwe	Lomwe	Yes	N	N32	lomw1241	639-3 ngl		yes
Echuwabo	Echuwabo	Yes	P	P34	chuw1238	639-3 chw		yes
Shona	Shona	Yes	S	S11	shon1251	639-3 sna		yes
Cinyungwe	Nyungwe	Yes	N	N43	nyun1248	639-3 nyu		yes
Bitonga	Tonga, Gitonga	Yes	S	S62	gito1238	639-3 toh		yes
Cicewa	Chichewa	Yes	N	N31	nyan1308	639-3 nya	Yes (Mal, Zam)	yes
Ciyao	Yao	Yes	P	P21	yaoo1241	639-3 yao	Yes (Mal)	yes
Cichopi	Copi, Cicopi	Yes	S	S61	chop1243	639-3 cce		yes
Cindau	Ndau	Yes	S	S15	ndau1241	639-3 ndc		yes
Shimakonde	Makonde	Yes	P	P23	mako1251	639-3 kde		yes
Chitewe	Tewe	Yes	S	S13	tewe1238	639-3 twx		yes
Xitswa	Tswa	Yes	S	S51	tswa1255	639-3 tsc		yes
UGANDA								
Baganda	Luganda, Ganda	Yes	JE	JE15	gand1255	639-3 lug		yes
Banyankole	Nyankore	Yes	JE	JE13	nyan1307	639-3 nyn		yes
Basoga	Soga	Yes	JE	JE16	soga1242	639-3 xog		yes
Bakiga	Kiga, Chiga	Yes	JE	JE14	chig1238	639-3 cgg		yes
Atesa	Teso, Ateso	No	n/a - Nilotic, Eastern Nilotic		teso1249	639-3 teo		no
Ngakaramajong	Karamojong	No	n/a - Nilotic, Eastern Nilotic		kara1483	639-3 kdj		no
Langi	Luo	No	n/a - Nilotic, Western Nilotic		luok1236	639-3 luo		no

Appendix. Table 7.3. Frequency of IPPV and IPSV for control and experimental variables used to test paternity concern hypotheses (n 20,610)

		IPPV	% of IPPV	IPSV	% of IPSV	TOTAL	% of TOTAL
	Total	**3252**	**15.8%**	**1757**	**8.5%**	**20610**	**100.0%**
Country	Burkina Faso	215	9.5%	29	1.3%	2268	11.0%
	Chad	137	13.5%	73	7.2%	1012	4.9%
	Ethiopia	263	14.0%	114	6.1%	1877	9.1%
	Gambia	30	8.2%	5	1.4%	367	1.8%
	Ghana	131	18.0%	34	4.7%	726	3.5%
	Ivory Coast	113	22.7%	20	4.0%	497	2.4%
	Kenya	378	24.7%	158	10.3%	1531	7.4%
	Malawi	409	15.3%	441	16.5%	2668	12.9%
	Mali	218	21.1%	108	10.5%	1031	5.0%
	Nigeria	261	7.8%	98	2.9%	3342	16.2%
	Togo	172	14.0%	64	5.2%	1228	6.0%
	Zambia	925	22.8%	613	15.1%	4063	19.7%
CATEGORICAL CONTROL VARIABLES							
Household wealth	Poorest	690	15.7%	398	9.0%	4406	21.4%
	Poorer	770	17.7%	427	9.8%	4354	21.1%
	Middle	721	18.0%	408	10.2%	3999	19.4%
	Richer	587	14.8%	324	8.2%	3963	19.2%
	Richest	484	12.4%	200	5.1%	3888	18.9%
Household residence	Urban	989	15.8%	451	7.2%	6272	30.4%
	Rural	2263	15.8%	1306	9.1%	14338	69.6%
Education (husband)	No education	757	12.1%	350	5.6%	6252	30.3%
	Primary	1362	19.0%	843	11.7%	7187	34.9%
	Secondary	989	17.5%	502	8.9%	5651	27.4%
	Higher	144	9.5%	62	4.1%	1520	7.4%
Religion (husband)	Muslim	747	10.4%	337	4.7%	7194	34.9%
	Christian	2254	18.5%	1323	10.8%	12207	59.2%
	Other/none	251	20.8%	97	8.0%	1209	5.9%
Alcohol use (husband)	No	1570	11.0%	914	6.4%	14336	69.6%
	Yes	1682	26.8%	843	13.4%	6274	30.4%
Transactional sex (husband)	No	2872	15.4%	1560	8.4%	18612	90.3%
	Yes	351	19.8%	193	10.9%	1776	8.6%
Number of unions (wife)	Once	2741	15.1%	1444	8.0%	18098	87.8%
	More than once	511	20.3%	313	12.5%	2512	12.2%
Number of unions (husband)	Once	2198	15.2%	1169	8.1%	14490	70.3%
	More than once	1054	17.2%	588	9.6%	6120	29.7%
Experienced IPPV last 12m	No	..	..	791	4.6%	17358	84.2%
	Yes	..	..	966	29.7%	3252	15.8%
Experienced IPSV last 12m	No	2286	12.1%	..	..	18853	91.5%
	Yes	966	55.0%	..	..	1757	8.5%
CATEGORICAL EXPERIMENTAL VARIABLES							
Jealous wife if talks to other men	No	868	8.7%	425	4.3%	9947	48.3%
	Yes	2359	22.5%	1317	12.6%	10492	50.9%
Accuses wife of unfaithfulness	No	1858	11.0%	943	5.6%	16890	82.0%
	Yes	1379	38.0%	805	22.2%	3626	17.6%
Insists knowing where she is at all times	No	1297	10.6%	488	4.0%	12199	59.2%
	Yes	1946	23.3%	1265	15.1%	8351	40.5%
Wife: sex before marriage	No	1903	14.1%	1017	7.5%	13535	65.7%
	Yes	1349	19.1%	740	10.5%	7075	34.3%
Wife: lifetime number of sexual partners	1	1688	13.1%	879	6.8%	12892	62.6%
	2	894	18.0%	457	9.2%	4969	24.1%
	3	427	23.3%	280	15.3%	1829	8.9%
	4+	243	26.4%	141	15.3%	920	4.5%
Husband: sex before marriage	No	908	12.8%	478	6.8%	7072	34.3%
	Yes	2344	17.3%	1279	9.4%	13538	65.7%
Husband: lifetime number of sexual partners	1	455	10.7%	239	5.6%	4250	20.6%
	2	612	14.6%	351	8.3%	4206	20.4%
	3	556	16.3%	303	8.9%	3413	16.6%
	4 +	1629	18.4%	864	9.8%	8741	21.3%

Appendix Table 7.3 cont.	IPPV Mean	(sd)	IPSV Mean	(sd)	TOTAL Mean	(sd)
SCALE CONTROL VARIABLES						
Wife's current age	29.9	7.3	30.0	7.2	30.2	7.6
Husband's current age	36.0	8.2	36.0	8.2	37.0	8.5
Number of IPV justifications agreed with by husband						
% father beat mother in husband ethnic group	29%	14%	31%	13%	23%	15%
SCALE EXPERIMENTAL VARIABLES						
Wife: average number sexual partners in ethnic group	1.9	0.5	1.9	0.4	1.7	0.5
Wife: prevalence of sex before marriage in ethnic group	40%	18%	42%	17%	35%	20%
Husband: average number sexual partners in ethnic group	5.7	2.4	5.5	2.2	5.1	2.4
Husband: prevalence of sex before marriage in ethnic group	72%	18%	72%	18%	66%	23%

Appendix Table 7.4. Frequency of IPPV and IPSV for control and experimental variables used to test reproductive conflict hypotheses (n25,577)

		IPPV	% of IPPV	IPSV	% of IPSV	TOTAL	% of TOTAL
	Total	**3252**	**15.8%**	**1757**	**8.5%**	**20610**	**100.0%**
Country	Burkina Faso	215	9.5%	29	1.3%	2268	11.0%
	Chad	137	13.5%	73	7.2%	1012	4.9%
	Ethiopia	263	14.0%	114	6.1%	1877	9.1%
	Gambia	30	8.2%	5	1.4%	367	1.8%
	Ghana	131	18.0%	34	4.7%	726	3.5%
	Ivory Coast	113	22.7%	20	4.0%	497	2.4%
	Kenya	378	24.7%	158	10.3%	1531	7.4%
	Malawi	409	15.3%	441	16.5%	2668	12.9%
	Mali	218	21.1%	108	10.5%	1031	5.0%
	Nigeria	261	7.8%	98	2.9%	3342	16.2%
	Togo	172	14.0%	64	5.2%	1228	6.0%
	Zambia	925	22.8%	613	15.1%	4063	19.7%
CATEGORICAL CONTROL VARIABLES							
Household wealth	Poorest	690	15.7%	398	9.0%	4406	21.4%
	Poorer	770	17.7%	427	9.8%	4354	21.1%
	Middle	721	18.0%	408	10.2%	3999	19.4%
	Richer	587	14.8%	324	8.2%	3963	19.2%
	Richest	484	12.4%	200	5.1%	3888	18.9%
Household residence	Urban	989	15.8%	451	7.2%	6272	30.4%
	Rural	2263	15.8%	1306	9.1%	14338	69.6%
Education (husband)	No education	757	12.1%	350	5.6%	6252	30.3%
	Primary	1362	19.0%	843	11.7%	7187	34.9%
	Secondary	989	17.5%	502	8.9%	5651	27.4%
	Higher	144	9.5%	62	4.1%	1520	7.4%
Religion (husband)	Muslim	747	10.4%	337	4.7%	7194	34.9%
	Christian	2254	18.5%	1323	10.8%	12207	59.2%
	Other/none	251	20.8%	97	8.0%	1209	5.9%
Alcohol use (husband)	No	1570	11.0%	914	6.4%	14336	69.6%
	Yes	1682	26.8%	843	13.4%	6274	30.4%
Transactional sex (husband)	No	2872	15.4%	1560	8.4%	18612	90.3%
	Yes	351	19.8%	193	10.9%	1776	8.6%
Number of unions (wife)	Once	2741	15.1%	1444	8.0%	18098	87.8%
	More than once	511	20.3%	313	12.5%	2512	12.2%
Number of unions (husband)	Once	2198	15.2%	1169	8.1%	14490	70.3%
	More than once	1054	17.2%	588	9.6%	6120	29.7%
Experienced IPPV last 12m	No	..	..	791	4.6%	17358	84.2%
	Yes	..	..	966	29.7%	3252	15.8%
Experienced IPSV last 12m	No	2286	12.1%	..	..	18853	91.5%
	Yes	966	55.0%	..	..	1757	8.5%
CATEGORICAL EXPERIMENTAL VARIABLES							
Jealous wife if talks to other men	No	868	8.7%	425	4.3%	9947	48.3%
	Yes	2359	22.5%	1317	12.6%	10492	50.9%
Accuses wife of unfaithfulness	No	1858	11.0%	943	5.6%	16890	82.0%
	Yes	1379	38.0%	805	22.2%	3626	17.6%
Insists knowing where she is at all times	No	1297	10.6%	488	4.0%	12199	59.2%
	Yes	1946	23.3%	1265	15.1%	8351	40.5%
Wife: sex before marriage	No	1903	14.1%	1017	7.5%	13535	65.7%
	Yes	1349	19.1%	740	10.5%	7075	34.3%
Wife: lifetime number of sexual partners	1	1688	13.1%	879	6.8%	12892	62.6%
	2	894	18.0%	457	9.2%	4969	24.1%
	3	427	23.3%	280	15.3%	1829	8.9%
	4+	243	26.4%	141	15.3%	920	4.5%
Husband: sex before marriage	No	908	12.8%	478	6.8%	7072	34.3%
	Yes	2344	17.3%	1279	9.4%	13538	65.7%
Husband: lifetime number of sexual partners	1	455	10.7%	239	5.6%	4250	20.6%
	2	612	14.6%	351	8.3%	4206	20.4%
	3	556	16.3%	303	8.9%	3413	16.6%
	4 +	1629	18.4%	864	9.8%	8741	21.3%

Appendix Table 7.4 cont.	IPPV Mean	(sd)	IPSV Mean	(sd)	TOTAL Mean	(sd)
SCALE CONTROL VARIABLES						
Wife's current age	29.9	7.3	30.0	7.2	30.2	7.6
Husband's current age	36.0	8.2	36.0	8.2	37.0	8.5
Number of IPV justifications agreed with by husband						
% father beat mother in husband ethnic group	29%	14%	31%	13%	23%	15%
SCALE EXPERIMENTAL VARIABLES						
Wife: average number sexual partners in ethnic group	1.9	0.5	1.9	0.4	1.7	0.5
Wife: prevalence of sex before marriage in ethnic group	40%	18%	42%	17%	35%	20%
Husband: average number sexual partners in ethnic group	5.7	2.4	5.5	2.2	5.1	2.4
Husband: prevalence of sex before marriage in ethnic group	72%	18%	72%	18%	66%	23%

CHAPTER 8 – APPENDICES

Appendix Table 8.1 Pearson correlation between FGC and IPV prevalence by ethnic group

Country	n	Pearson's r	p value
Gambia	6	0.196	0.710
Nigeria	13	-0.091	0.768
Ethiopia	10	-0.246	0.493
Kenya	18	0.101	0.691
Ivory Coast	15	0.372	0.173
Burkina Faso	11	0.112	0.745

Appendix Table 8.2. Characteristics of the study sample by IPV experience

		Did not experience IPV		Experienced IPV		Total	
		N	%	N	%	N	%
FGC status	**FGC**	11,059	40.5%	1,602	41.7%	12,661	40.6%
	No FGC	16,265	59.5%	2,244	58.3%	18,509	59.4%
Household wealth	**Poorest**	6,176	22.6%	802	20.9%	6,978	22.4%
	Poorer	5,294	19.4%	825	21.5%	6,119	19.6%
	Middle	4,797	17.6%	743	19.3%	5,540	17.8%
	Richer	5,265	19.3%	791	20.6%	6,056	19.4%
	Richest	5,792	21.2%	685	17.8%	6,477	20.8%
Household location	**Urban**	9,475	34.7%	1,360	35.4%	10,835	34.8%
	Rural	17,849	65.3%	2,486	64.6%	20,335	65.2%
Woman's education	**None**	15,445	56.5%	1,781	46.3%	17,226	55.3%
	Primary	5,439	19.9%	1,210	31.5%	6,649	21.3%
	Secondary +	6,440	23.6%	855	22.2%	7,295	23.4%
Marriage type	**Monogamous**	20,835	76.3%	2,946	76.6%	23,781	76.3%
	Polygamous	6,489	23.7%	900	23.4%	7,389	23.7%
Husband drinks alcohol	**No**	21,722	79.5%	2,248	58.5%	23,970	76.9%
	Yes	5,602	20.5%	1,598	41.5%	7,200	23.1%
Father beat mother	**No**	24,043	88.0%	2,622	68.2%	26,665	85.5%
	Yes	3,281	12.0%	1,224	31.8%	4,505	14.5%
TOTAL		**27,324**	**87.7%**	**3,846**	**12.3%**	**31,170**	**100.0%**
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Respondent's age		30.9	8.4	30.9	7.9	30.9	1.07
No. of control behaviours experienced		0.9	1.1	1.9	1.5	1.1	1.2
No. HH decisions involved in		1.7	1.6	2.0	1.5	1.8	1.6
Average no. IPV justifications agreed with by men in ethnic group		0.66	0.37	0.75	0.50	0.67	0.39

Appendix Table 8.3: Characteristics of the study sample by FGC support

		FGC should be stopped		FGC should be continued		Total	
		N	%	N	%	N	%
IPV experience in last 12m	**No IPV**	20,729	87.1%	6,415	88.4%	27,144	87.4%
	IPV	3,081	12.9%	842	11.6%	3,923	12.6%
Household wealth	**Poorest**	4,324	18.2%	2,431	33.5%	6,755	21.7%
	Poorer	4,458	18.7%	1,521	21.0%	5,979	19.2%
	Middle	4,452	18.7%	1,153	15.9%	5,605	18.0%
	Richer	4,971	20.9%	1,176	16.2%	6,147	19.8%
	Richest	5,605	23.5%	976	13.4%	6,581	21.2%
Household location	**Urban**	8,716	36.6%	2,292	31.6%	11,008	35.4%
	Rural	15,094	63.4%	4,965	68.4%	20,059	64.6%
Woman's education	**None**	12,273	51.5%	4,626	63.7%	16,899	54.4%
	Primary	5,537	23.3%	1,221	16.8%	6,758	21.8%
	Secondary +	6,000	25.2%	1,410	19.4%	7,410	23.9%
Living daughters	**None**	6,005	25.2%	1,783	24.6%	7,788	25.1%
	One or more	17,805	74.8%	5,474	75.4%	23,279	74.9%
Woman's religion	**Muslim**	11,188	47.0%	5,578	76.9%	16,766	54.0%
	Christian	11,363	47.7%	1,417	19.5%	12,780	41.1%
	Other/none	1,259	5.3%	262	3.6%	1,521	4.9%
FGC status	**FGC**	11,267	47.3%	1,062	14.6%	12,329	39.7%
	No FGC	12,543	52.7%	6,195	85.4%	18,738	60.3%
Exposure to mass media	**Never**	6,206	26.1%	2,585	35.6%	8,791	28.3%
	Infrequent	4,832	20.3%	1,426	19.6%	6,258	20.1%
	Frequent	12,772	53.6%	3,246	44.7%	16,018	51.6%
TOTAL		23,810	76.6%	7,257	23.4%	31,067	100.0%
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Respondent's age		31.1	8.3	30.6	8.5	31.0	8.4
No. of control behaviours experienced		1.1	1.2	1.1	1.2	1.1	1.2
No. of HH decisions involved in		1.8	1.6	1.8	1.5	1.8	1.6
No. of IPV justifications agreed with		1.2	1.7	1.8	1.9	1.3	1.7
FGC% in ethnic group		53%	29%	68%	27%	57%	30%

Appendix Table 8.4. IPV experience: Single level multivariate logistic regression models analysing factors associated with women's IPV experience in past year, by country

		Gambia			Nigeria			Ethiopia			Kenya			Ivory Coast			Burkina Faso		
		OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Individual variables																			
FGC status (No FGC)	FGC	1.15	0.77 - 1.71	0.493	1.13	0.97 - 1.32	0.115	1.05	0.79 - 1.40	0.729	1.10	0.88 - 1.37	0.400	1.27	1.01 - 1.59	0.043	0.99	0.82 - 1.22	0.972
Household wealth (Poorest)	Poorer	0.58	0.38 - 0.90	0.014	1.18	0.91 - 1.54	0.210	1.18	0.84 - 1.66	0.339	1.30	0.97 - 1.75	0.078	1.09	0.84 - 1.42	0.530	1.24	0.96 - 1.62	0.103
	Middle	0.68	0.42 - 1.10	0.119	1.25	0.94 - 1.66	0.132	0.82	0.57 - 1.18	0.290	0.93	0.68 - 1.28	0.669	0.90	0.65 - 1.23	0.502	1.30	1.00 - 1.69	0.052
	Richer	0.47	0.25 - 0.91	0.024	0.99	0.73 - 1.35	0.971	0.85	0.59 - 1.23	0.396	0.88	0.62 - 1.23	0.438	1.11	0.77 - 1.60	0.588	1.32	1.02 - 1.73	0.039
	Richest	0.49	0.25 - 0.96	0.036	0.82	0.58 - 1.14	0.236	0.60	0.36 - 1.00	0.050	0.53	0.35 - 0.80	0.002	0.97	0.62 - 1.50	0.877	1.28	0.92 - 1.78	0.149
Household location (Urban)	Rural	0.52	0.31 - 0.86	0.011	0.98	0.83 - 1.16	0.844	1.16	0.71 - 1.91	0.548	1.13	0.90 - 1.42	0.284	0.92	0.68 - 1.26	0.607	0.91	0.72 - 1.14	0.397
Woman's age		0.99	0.97 - 1.01	0.286	0.99	0.98 - 1.00	0.019	1.00	0.98 - 1.01	0.505	0.99	0.98 - 1.01	0.257	1.00	0.99 - 1.01	0.820	1.01	1.00 - 1.02	0.122
Woman's education (None)	Primary	1.30	0.86 - 1.97	0.214	1.52	1.21 - 1.91	0.000	1.03	0.78 - 1.34	0.850	1.05	0.74 - 1.49	0.792	1.09	0.86 - 1.37	0.484	1.11	0.88 - 1.41	0.384
	Secondary +	1.23	0.84 - 1.82	0.286	1.32	1.03 - 1.69	0.026	0.93	0.60 - 1.43	0.728	0.98	0.66 - 1.47	0.922	0.61	0.42 - 0.88	0.008	0.75	0.53 - 1.07	0.109
Marriage type (Monog)	Polygamous	0.89	0.62 - 1.27	0.518	1.36	1.15 - 1.61	0.000	1.37	0.96 - 1.96	0.085	1.43	1.09 - 1.87	0.010	1.02	0.82 - 1.28	0.843	1.17	0.97 - 1.40	0.094
Husband drinks alcohol (No)	Yes	2.16	0.57 - 8.21	0.258	2.56	2.18 - 3.01	0.000	2.05	1.60 - 2.62	0.000	2.80	2.31 - 3.39	0.000	1.36	1.10 - 1.68	0.004	2.00	1.70 - 2.36	0.000
Father beat mother (No)	Yes	2.35	1.63 - 3.40	0.000	2.16	1.78 - 2.62	0.000	2.03	1.62 - 2.54	0.000	1.93	1.60 - 2.33	0.000	1.53	1.20 - 1.96	0.001	3.66	3.02 - 4.43	0.000
No. controlling behaviours experienced		1.67	1.51 - 1.85	0.000	1.77	1.68 - 1.87	0.000	1.83	1.70 - 1.98	0.000	1.79	1.67 - 1.91	0.000	1.52	1.42 - 1.63	0.000	1.64	1.54 - 1.75	0.000
No. HH decisions wife involved in (0-5)		0.94	0.83 - 1.06	0.302	1.07	1.02 - 1.13	0.006	0.95	0.87 - 1.03	0.196	0.90	0.84 - 0.97	0.005	0.93	0.87 - 1.00	0.036	1.09	1.01 - 1.16	0.018
Contextual variable																			
Average number of IPV justifications agreed with by men in ethnic group		1.18	0.50 - 2.79	0.711	1.29	0.84 - 1.97	0.248	7.68	3.82 - 15.4	0.000	0.94	0.80 - 1.11	0.470	1.28	0.97 - 1.68	0.087	0.41	0.28 - 0.61	0.000

Sample size: Gambia (n2,574), Nigeria (n10,720), Ethiopia (n3,086), Kenya (n3,158), Ivory Coast (n2,771), Burkina Faso (n8,861)

Appendix Table 8.5. Single level multivariate logistic regression models analysing factors associated with women's agreement that FGC should be continued, by country

		Gambia			Nigeria			Ethiopia			Kenya			Ivory Coast			Burkina Faso		
		OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Individual variables																			
IPV during last 12 months (No)	Yes	0.67	0.46 - 0.99	0.044	1.02	0.86 - 1.22	0.803	0.73	0.56 - 0.94	0.017	0.88	0.59 - 1.32	0.540	1.43	1.11 - 1.86	0.007	1.47	1.14 - 1.89	0.003
Household wealth (poorest)	Poorer	1.06	0.78 - 1.44	0.717	0.80	0.68 - 0.93	0.005	0.62	0.48 - 0.79	0.000	1.01	0.62 - 1.64	0.977	0.90	0.66 - 1.22	0.502	0.84	0.67 - 1.05	0.124
	Middle	0.89	0.62 - 1.26	0.501	0.63	0.52 - 0.75	0.000	0.42	0.31 - 0.55	0.000	0.88	0.49 - 1.59	0.682	0.79	0.53 - 1.18	0.247	0.79	0.63 - 0.99	0.043
	Richer	1.45	0.86 - 2.43	0.161	0.63	0.52 - 0.78	0.000	0.45	0.33 - 0.60	0.000	1.22	0.66 - 2.26	0.524	0.38	0.23 - 0.64	0.000	0.59	0.46 - 0.76	0.000
	Richest	1.05	0.61 - 1.79	0.874	0.54	0.42 - 0.68	0.000	0.30	0.19 - 0.46	0.000	0.96	0.45 - 2.06	0.925	0.22	0.11 - 0.43	0.000	0.73	0.52 - 1.02	0.064
Household location (Urban)	Rural	0.90	0.60 - 1.34	0.596	1.16	1.02 - 1.31	0.024	0.95	0.64 - 1.42	0.810	1.01	0.65 - 1.55	0.981	0.83	0.55 - 1.25	0.373	1.08	0.85 - 1.38	0.540
Woman's age		0.98	0.96 - 0.99	0.004	0.99	0.98 - 1.00	0.000	0.98	0.97 - 1.00	0.014	0.99	0.96 - 1.01	0.193	0.97	0.96 - 0.99	0.000	0.99	0.98 - 1.00	0.058
Woman's education (None)	Primary	1.01	0.71 - 1.42	0.979	0.69	0.58 - 0.81	0.000	0.63	0.50 - 0.79	0.000	0.39	0.26 - 0.60	0.000	0.74	0.53 - 1.03	0.078	0.93	0.71 - 1.22	0.591
	Secondary +	0.79	0.58 - 1.07	0.125	0.68	0.56 - 0.82	0.000	0.34	0.21 - 0.55	0.000	0.17	0.09 - 0.32	0.000	0.53	0.28 - 0.98	0.043	0.30	0.16 - 0.57	0.000
Living daughters (None)	One or more	1.04	0.95 - 1.14	0.426	1.00	0.96 - 1.04	0.857	1.07	0.99 - 1.15	0.074	1.08	0.95 - 1.23	0.221	0.96	0.87 - 1.05	0.369	0.97	0.91 - 1.04	0.361
Woman's religion (Muslim)	Christian	0.41	0.14 - 1.24	0.113	0.38	0.33 - 0.43	0.000	0.62	0.50 - 0.77	0.000	0.17	0.12 - 0.26	0.000	0.45	0.32 - 0.65	0.000	0.42	0.33 - 0.53	0.000
	Other/none				0.69	0.39 - 1.22	0.199	0.37	0.08 - 1.81	0.221	0.14	0.05 - 0.38	0.000	0.99	0.73 - 1.34	0.932	1.01	0.78 - 1.30	0.945
FGC status (No FGC)	FGC	53.67	35.50 - 81.12	0.000	5.50	4.88 - 6.20	0.000	2.96	2.01 - 4.38	0.000	4.04	2.37 - 6.90	0.000	13.03	8.26 - 20.5	0.000	7.11	4.70 - 10.7	0.000
Exposure to mass media (None)	Infrequent	1.07	0.72 - 1.59	0.748	0.81	0.70 - 0.93	0.004	1.15	0.87 - 1.52	0.320	0.53	0.32 - 0.87	0.013	0.92	0.67 - 1.26	0.598	0.68	0.55 - 0.84	0.000
	Frequent	1.30	0.90 - 1.87	0.160	0.69	0.60 - 0.80	0.000	0.94	0.71 - 1.24	0.664	0.45	0.30 - 0.68	0.000	0.97	0.71 - 1.32	0.835	0.83	0.69 - 1.00	0.048
No. of HH decisions wife involved in (0-5)		1.00	0.91 - 1.10	0.969	0.93	0.90 - 0.97	0.000	0.95	0.89 - 1.01	0.104	0.98	0.88 - 1.10	0.774	1.08	1.00 - 1.18	0.051	0.99	0.92 - 1.07	0.816
No. of IPV justifications wife agrees with (0-5)		1.07	1.00 - 1.15	0.053	1.17	1.14 - 1.21	0.000	1.04	0.99 - 1.09	0.100	1.12	1.02 - 1.23	0.021	1.05	0.99 - 1.12	0.089	1.18	1.13 - 1.23	0.000
No. of controlling behaviours wife experiences (0-5)		1.02	0.92 - 1.13	0.715	0.94	0.90 - 0.98	0.004	1.03	0.96 - 1.12	0.391	1.00	0.88 - 1.12	0.933	1.04	0.95 - 1.14	0.447	1.12	1.04 - 1.21	0.002
Contextual variables																			
FGC prevalence in ethnic group (%)		0.04	0.02 - 0.06	0.000	0.08	0.06 - 0.11	0.000	0.803	0.03 - 0.13	0.000	0.017	0.06 - 0.19	0.000	0.540	0.01 - 0.02	0.992	0.007	0.01 - 0.03	0.374

Sample size: Gambia (n2,801), Nigeria (n10,090), Ethiopia (n3,201), Kenya (n3,318), Ivory Coast (n2,780), Burkina Faso (n8,877)

CHAPTER 9 – APPENDICES

Appendix Table 9.1 Summary of variables used in research analyses

CHAPTER	Chapter 5: Is there a link between paternity concern and female genital cutting in West Africa?			Chapter 6: Frequency-dependent female genital cutting behaviour confers evolutionary fitness benefits		Chapter 7: Can evolutionary sexual conflict help to explain patterns of male-to-female IPV?			Chapter 8: Testing for an association between FGC and IPV in six countries in sub-Saharan Africa	
Outcome and primary experimental variable	**1) Extra-pair sex indicators with FGC**	**2) Age at marriage and FGC status**	**3) Paternity concern proxies and wife's FGC status f)**	**1) Having a daughter with FGC**	**2) Reproductive success and FGC status**	**1) Indicators of paternity concern and IPV**	**2) Indicators of reproductive conflict and IPV**	**3) Full model and IPV**	**1) IPV experience and FGC status**	**2) FGC support and IPV experience**
Countries	5 countries: Nigeria, Burkina Faso, Senegal, Ivory Coast, Mali			5 countries: Nigeria, Burkina Faso, Senegal, Ivory Coast, Mali		12 countries: Burkina Faso, Chad, Ethiopia, Gambia, Ghana, Ivory Coast, Kenya, Malawi, Mali, Nigeria, Togo and Zambia			6 countries: Nigeria, Kenya, Ivory Coast, Burkina Faso, Ethiopia, Gambia	
Selection criteria	All DHS datasets which includes FGC status, and ethnic FGC% ranges <50% to >50%			All DHS datasets which includes FGC status, and ethnic FGC% ranges <50% to >50%		All DHS datasets with IPV module, where husband and wife can be matched			DHS datasets where FGC and IPV modules used. FGC% between 10-90%.	
Sample	Women n12,395 - 41,996 g)	Women n48,231	Couples n10,695	Women n36,038	Women n10,067	Couples n20,610	Couples 24,577	Couples n20,610	Women n31,170	Women n31,170
Sample criteria	Identifiable ethnic group, known FGC status		Man plus first wife only	Known ethnic group and FGC status, 1+ living daughter.	Women aged 40-49 years	Currently married, duplicates from polygamous marriages excluded, known ethnic group, group size >50 individuals			Currently married, Known FGC status, ethnic group known.	
Analysis type	Multilevel logistic regression	Cox regression, multilevel	Multilevel logistic regression	Logistic regression, single and multilevel	Multilevel linear regression	Multilevel logistic regression	Multilevel logistic regression	Multilevel logistic regression	Logistic regression, single and multilevel	Logistic regression, single and multilevel
Outcome	6 extra-pair sex indicators among women	Age at first marriage	FGC status of first wife	One or more daughters with FGC	Number surviving offspring	Sexual IPV Physical IPV	Sexual IPV Physical IPV	Sexual IPV Physical IPV	IPV (sexual and/or physical) in past year	Agree with the statement that FGC should be continued

Notes

a) sample restricted to women aged 40-49yrs

b) Variables inlcuded as appropriate in model depending on specific EPC variable being tested

c) Household wealth relates to husband not wife

d) Each variable added separately to control model

e) Two models run, one with FGC status (yes/no), one with FGC type (none/'nicked'/flesh removed/sewn)

f) Model variations tested; FGC% restricted to 20-80%; excluded Ivory Coast; only matrilineal groups

g) n varies depending on specific outcome variable

Appendix Table 9.1 Summary of variables used in research analyses (cont.)

CHAPTER	Chapter 5: Is there a link between paternity concern and female genital cutting in West Africa?			Chapter 6: Frequency-dependent female genital cutting behaviour confers evolutionary fitness benefits		Chapter 7: Can evolutionary sexual conflict help to explain patterns of male-to-female IPV?			Chapter 8: Testing for an association between FGC and IPV in six countries in sub-Saharan Africa	
Outcome and primary experimental variable	**1) Extra-pair sex indicators with FGC**	**2) Age at marriage and FGC status**	**3) Paternity concern proxies and wife's FGC status f)**	**1) Having a daughter with FGC**	**2) Reproductive success and FGC status**	**1) Indicators of paternity concern and IPV**	**2) Indicators of reproductive conflict and IPV**	**3) Full model and IPV**	**1) IPV experience and FGC status**	**2) FGC support and IPV experience**
Individual level predictors										
Woman's FGC type	✓ e)									
Woman's FGC status (yes/no)	✓ e)	✓		✓	✓				✓	✓
Woman's religion	✓	✓		✓	✓					✓
Woman's education	✓	✓		✓	✓				✓	✓
Woman's age	✓	✓		✓	a)	✓	✓	✓	✓	✓
Household wealth	✓	c)	✓	✓	✓	✓	✓	✓	✓	✓
Household location (rural/urban)	✓	✓	✓			✓	✓	✓	✓	✓
Matrilineal/patrilineal	✓									
Monogamous/polygamous			✓				✓	✓	✓	
Couple fertility preference comparison							✓	✓		
Number of living children comparison							✓	✓		
Woman: Age at 1st intercourse	✓ b)									
Woman: Age at 1st marriage	✓ b)									
Woman: Ever married	✓ b)									
Woman: More than one marriage						✓		✓		
Woman: premarital sex						✓				
Woman: no. sexual partners						✓		✓		
Woman: fertility preference							✓			
Woman: Number of living children							✓			
Woman: Employment/earnings							✓	✓		
Woman: Father beat mother									✓	
Woman: No. controlling behaviours experienced									✓	
Woman: No. HH decisions participates in									✓	
Woman: No. IPV justifications agrees with										
Woman: Experienced any IPV										✓
Woman: Number of daughters										✓
Woman: Exposure to mass media										✓

Appendix Table 9.1 Summary of variables used in research analyses (cont.)

CHAPTER	Chapter 5: Is there a link between paternity concern and female genital cutting in West Africa?			Chapter 6: Frequency-dependent female genital cutting behaviour confers evolutionary fitness benefits		Chapter 7: Can evolutionary sexual conflict help to explain patterns of male-to-female IPV?			Chapter 8: Testing for an association between FGC and IPV in six countries in sub-Saharan Africa	
Outcome and primary experimental variable	**1) Extra-pair sex indicators with FGC**	**2) Age at marriage and FGC status**	**3) Paternity concern proxies and wife's FGC status f)**	**1) Having a daughter with FGC**	**2) Reproductive success and FGC status**	**1) Indicators of paternity concern and IPV**	**2) Indicators of reproductive conflict and IPV**	**3) Full model and IPV**	**1) IPV experience and FGC status**	**2) FGC support and IPV experience**
Individual level predictors (contd.)										
Man's age			✓			✓	✓	✓		
Man's religion			✓			✓	✓	✓		
Man's age at marriage			✓							
Man's education			✓			✓	✓			
Man's absence from home			✓ d)							
Man: premarital sex			✓ d)			✓				
Man: extramarital sex			✓ d)				✓	✓		
Man: total no. sexual partners			✓ d)			✓				
Man: number of IPV justifications						✓	✓	✓		
Man: paid for sex						✓		✓		
Man: more than one marriage						✓		✓		
Man: fertility preference							✓			
Man: number of living children							✓			
Husband jealous						✓		✓		
Husband accuses of infidelity						✓		✓		
Husband insists knowing where wife is						✓		✓		
Husband: drinks alcohol						✓	✓	✓	✓	
Group level predictors										
Woman's ethnic FGC%		✓			✓					✓
Man's ethnic FGC%			✓ d)							
Average no. IPV justifications agreed with by men in woman's ethnic group									✓	
Men: % premarital sex			✓ d)			✓				
Men: % extramarital sex			✓ d)							
Men: average no. sexual partners			✓ d)			✓				
Women: % premarital sex			✓ d)			✓				
Women: % extramarital sex			✓ d)							
Women: average no. sexual partners			✓ d)			✓				
Childhood exposure to IPV						✓	✓	✓		
Cross level interaction										
Ethnic FGC% x Mother's FGC status					✓					
Country level predictors										
Years since FGC was made illegal						✓				

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